THE INDIAN FORESTER

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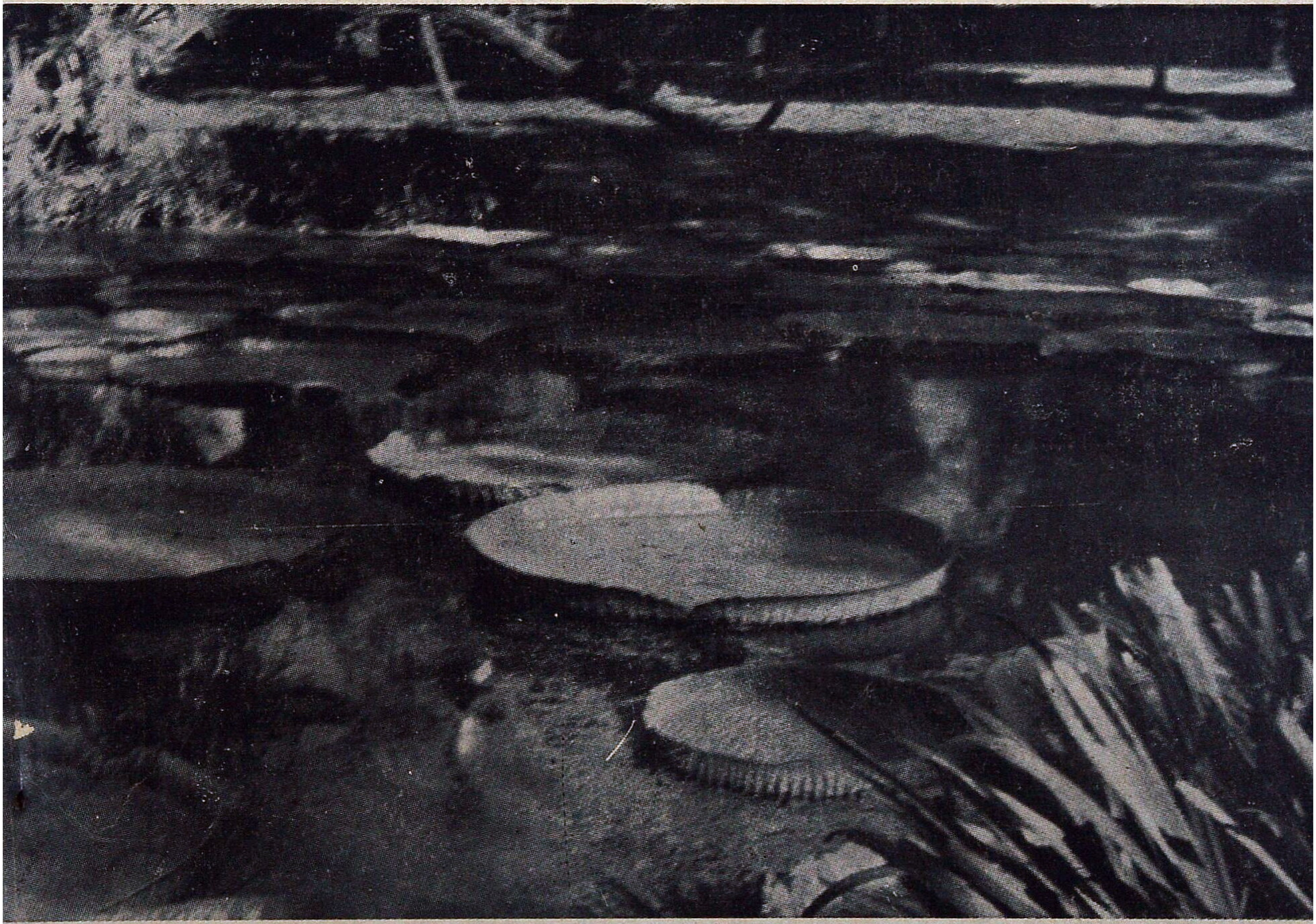

Volume 114 MARCH 1988 No. 3

Telegram Indian Forester

Telephone : 27021/264

INDIAN FORESTER

(A Monthly Journal of Forestry and Forestry Research)

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VOLUME 114 NUMBER 3

25 மே 1988
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THE
INDIAN FORESTER
MARCH, 1988

SOME DIMENSIONS OF BENEFITS FROM COMMUNITY FORESTRY A CASE STUDY REGARDING THE FLOW OF BENEFITS FROM THE DHANORI VILLAGE WOODLOT

D.P.S. VERMA*

Introduction

Little did the villagers of tiny Dhanori village of Valsad District in South Gujarat realise, on the eventful day of 23rd August 1974, that history was being made by their decision to part with four hectares of their traditional community grazing land for the purpose of raising a village woodlot for fuel and fodder production under the then newly introduced scheme of the Forest Department of Gujarat State. The decision was taken in a true democratic manner and spirit by the elected body of the village under a shady mango tree which perhaps, inspired them to do so. This reminds one of Buddha's enlightenment under a Bodhi tree!

Background

Gujarat is a relatively urbanised State by Indian standards, highly industrialized and with a well developed agriculture. Consequently, there is little scope for diverting land from any of the present uses to forestry.

In 1974, the Government of Gujarat initiated an innovative scheme of raising village forests on community land in all the 18,275 villages of the State in a phased manner. Gujarat where Gandhiji was born, lies in the north of the west coast of the Indian sub-continent. It has barely 10% of its land under forests, which produces a meagre 13%, 5% and 18% of its timber, small timber (poles) and firewood requirements respectively. The rest of the demand is either met by imports from the adjoining States or gathered from Wastelands, common grazing lands (Gauchers–C.G.L.S.) and farm lands. The forests are confined to the eastern and southern borders of the State. The situation, arising out of this irregular distribution, is aggravated by the absence of trees from about half of them.

The chronic shortage of forest produce, specially firewood, forces the use of cow-dung as fuel on a very large scale in the State. Some experts have estimated

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cattle. They also perform duties of creditors for the poor families of the village. Thus, their command over the village is total.

117 families of small farmers, who own 30% of the land, are more nearer to bigger farmers whereas 258 families of marginal farmers owning 36% of land, are more close to landless in all respects and work as a bridge between them. The economic status of various families is directly proportion to the land holding pattern in the village. The C.G L, constituting 3% of total land, can hardly contribute to the economy of the poor sections of society as it hardly produces anything. Table 2 indicates Land ownership pattern in the village.

Live stock : The village has a cattle population of about 620 which traditionally used to graze on its degraded community owned C. G. L. spread over about 28 ha. The cattle ownership pattern of the village is given in Table 3.

Creation of Dhanori Village Forest

No sooner had the Government of Gujarat announced the scheme for raising Village Woodlots on village grazing lands than the simple folk of Dhanori village came forward to offer four hectares of their land. This followed the second visit of Mr. M.I. Shaikh (the local Range Forest Officer) and Mr. B P. Bagul (Forester) who first approached them with the details of the scheme. On their first visit, Shaikh and associates tried their best to convince the villagers about the benefits of the scheme, especially to the poorer sections of society. The villagers were quite receptive, so much so that they knew the importance of trees as a regulator of rains, controller of floods and the answer for turning their hitherto unproductive grazing land to some productive use. However, they nourished some hidden hostility which they did not like to share with Shaikh and his party. The party returned with mixed feelings but with a determined will to continue. Agreement was reached on the second trip to the

Table 2

Land ownership in Dhanori

Type of land	No. of families	Area owned (ha)	Per cent of total area
Area under agriculture			
(a) Big farmers	40	264	30.42
(b) Small farmers	117	262	30.18
(c) Marginal farmers	250	314	36.18
Grazing lands (Panchayat)	—	28	3.22
Total	415	868	100.00
Average Holding per family		2.02	

Table 3

Cattle ownership in Dhanori

Category	No. of families	No. of cattle owned	Per cent to total cattle	Average no. of cattle per household
Big farmers	40	275	44.36	6 88
Small farmers	117	70	11.30	0.60
Marginal farmers	258	135	21.77	0.52
Landless	305	140	22.58	0 46
Total	720	620	100.00	0 86

village. Subsequently, when mutual trust was established, it was learnt from villagers that at the time of the first visit, the villagers had their own reservations about the continued ownership of their land once it was handed over to the Forest Department for raising trees. The villagers also made their own inquiries in this respect through their channels of information and when they found that their fear was unfounded, they came forward willingly to join the scheme.

Plantation Management

With the active participation of the villagers, which came in the form of providing local labourers needed for various forestry operations, providing tools for working, ensuring protection through community efforts and last but not the least by extending a warm welcome to forestry personnel on their visits to village, the Forest Department established the plantations of *Casuarina equisetifolia* (Saru) during the 1974 rains. *Casuarina* was specially selected because it suited the site the most and villagers wanted it. In all, 1680 naked root seedlings with an average height of 45 cm were planted at a spacing of 5 m × 5 m in hurriedly dug pits of 30 cm^3. The plantation was carried out under rainfed conditions, with three weedings in the first year, two in the second and one in third year. The area was protected by a cheap fencing erected from Bamboos and bailing wire. A part time watchman was also provided during the first three years who also partly carried out weeding, mulching etc. during IInd and IIIrd year The watchman could cope up with work because there were only 1680 trees to be looked after and villagers co-operated considerably in protection. The subsequent protection was taken over by villagers. The break up of expenditure is given in Table 5. The State spent a total of Rs. 3324.00 over three years (Rs. 831/ha).

Production

The area responded well to the closure from the first year of the treatment, a good growth of grass was obtained from the root stock of *Chloris verigata* which had never been allowed to develop owing to incessant heavy grazing. The grass production and the revenue in the first four years are given in Table 4. This represents incremental yield and income.

Table 4

Grass Production & Revenue

Year	Harvested grass (Quintal)	Revenue realised. (Rs)
1974	30.00	455
1975	178.00	2617
1976	37.00	556
1977	93.00	1401
Total :	338.00	5029

In the year 1976, there was no local market for grass due to higher production in the locality resulting from good rains which has reduced the revenue.

It is of interest to mention here that according to the agreement between the village community and the Forest Department, the villagers were given the option of either removing the grass free on headloads by direct cutting or to sell the same. The Dhanori village chose to sell the grass because they had enough additional grazing area available for the village cattle and saw more benefits in sale rather than in community distribution, which is quite often difficult. After 1977, the sale of grass was not possible mainly due to a decline in production because of canopy closure. The area produced negligible quantity of grass after 1977 which was sparingly removed by headloads as area is situated quite far away from the village. Unfortunately, no records of this removal were maintained.

By the end of 1982, trees had grown to an average girth of 50 to 60 cms and a height of 15 to 18 meters. The villagers started feeling that trees had grown to a full size and hence should be felled Their wishes were respected and consequently marking of trees was undertaken during 1982-83 and felling done during 1983-84. At the time of felling, there were 1194 surviving trees (a survival rate of 75%) varying from 20 cm to 150 cm in girth. The harvest yielded 1840 pieces of timber measuring 51.140 m^3 and 605 quintals of firewood giving a mean annual increment of 4.12 m^3 per hectare per year.

Distribution of Benefits

The material was converted and brought to the village depot for final disposal with the help of local labourers. With this started the acid test of distribution of benefits from the common property resource. It was at this stage that a major policy decision was taken to keep Government machinery out of the distribution and leave the major decisions to the elected body of the village. It was in this background that the elected body met at Dhanori on the 23rd of July, 1983. The department made arrangements to make the services of the local Conservator of Forests available for any guidance in case the elected body needed the same for distributing the benefits. The Village Panchayat made the following decisions :

(1) All the labourers coming for exploitation work should be permitted to remove lops and tops for firewood free of charge on headloads. About 140 quintals of firewood valued at Rs. 3,360 were removed in this way. The benefit mainly went to 140 families of landless labourers. Incidentally, these were the very families who also participated in planting and grass cutting operations.

(2) The people of the village, especially small and marginal farmers, should be permitted to remove firewood at a conces-

Table 5

Financial Returns

Type of material.	Quantity.	Market price (Rs.)	Price recovered (Rs.)	Indirect subsidy (Rs.)
(A) *Timber* :				
Given at concessional rate.	5.626 m^3	9,560	5,736	3,824
By open auction.	45.514 m^3	36,997	36,997	—
Total :	51 140 m^3	46,557	42,733	3,824
(B) *Firewood* :				
Lops & tops.	140 Qtl.	3,360	—	3,360
Removed by carts.	460 Qtl.	11,040	575	10,465
By open auction.	5 Qtl.	120	120	—
Total :	605 Qtl.	14,520	695	13,825
(C) *Grass* :				
Revenue from Grass.	338 Qtl.	5,029	5,029	—
Grand Total :				
(a) Timber.	51.140 m^3			
(b) Firewood.	605 Qtl.	66,106	48,457	17,649
(c) Grass.	338 Qtl.			
(d) Expenditure.		8,268		
(e) Net Returns.		57,838		

sional rate of Rs. 12.50 per tonne. The quantity of the firewood so distributed was decided in the meeting. 460 quintals of firewood priced at Rs. 11,040 was distributed to the villagers after recovering an amount of Rs. 575. This amounted to a subsidy of Rs. 10,465 to the beneficiaries, mainly comprising of marginal and small farmers.

(3) It was also decided that the Village Panchayat should ascertain the household requirements for rafters from the inhabitants of village and supply the same to them for their own bonafide use at 60% of the market rates. With the help of the Conservator of Forests, the prevailing market price of rafters was fixed at Rs. 20 and Rs. 16 per piece for big (girth 23 cm to 30 cm) and small (girth below 23 cm) rafters respectively. Consequently, 600 pieces measuring 5.626 m^3 and valued at Rs. 9,560 were distributed to 44 persons, the majority of whom were landless and small/marginal farmers. An amount of Rs. 5,736 was recovered, involving a subsidy of Rs 3,824. The Village Panchayat also took advantage of this decision and appropriated rafters valued at Rs. 480 by paying only Rs. 288 and thereby utilizing a subsidy of Rs 192.00.

(4) It was further decided by the Village Panchayat that extra material, namely timber and firewood not needed by the village community in the manner indicated above should be sold by public auction. The remaining quantity of timber 45.514 m^3 and 5 quintals of firewood were therefore sold in this way in open auction, realising a revenue of Rs. 37,117. The revenue was shared on 50 : 50 basis between Village Panchayat and Forest Department in accordance with the agreement between them.

Analysis of Benefits

The benefits from the activity can be analysed on the basis of two criteria namely (a) from financial returns and (b) benefits to the people.

Financial : Financial analysis has been made based strictly on the financial returns of the activity. While undertaking this analysis, the benefits (subsidies) given to community have not been ignored.

From the above, it will be seen that as much as 11% of timber and 99% of firewood were used locally.

There are no natural forests in the village The CGL was so depleted that it neither produced a blade of grass much less any firewood. Thus, the entire production represents the incremental production.

The local population specially the landless and marginal farmers used together firewood by way of surrendering part of their wages towards its costs and at times steal from farm lands. The timber had to be purchased from open market.

Table 2 indicates that as such as 24% (value basis) of Timber and firewood were distributed to villagers free of cost. The total turn out of activity was Rs. 66,106 and an expenditure of Rs. 8,268 (Rs. 3,324 on plantation action + Rs. 4,944 on harvesting) was incurred. Thus, the net revenue from the activity worked out to Rs. 57,838. A subsidy (benefits) of Rs. 17,649 was given to individual beneficiaries of different economical strata.

Distribution of Benefits (Subsidy) : An amount of Rs. 17,649 was the grant of subsidy to the under-privileged of the community. In addition, an amount of Rs. 13,354 was distributed towards wages to the local landless. In the absence of alternate employment, this amount also reflects the marginal benefits to the community. Thus, the total benefits to the community works out to be Rs. 31,003 Composition of this subsidy is indicated in Table 6.

The poor get the maximum : Various sections of society have gained from this activity in various ways. Looking strictly from financial view, people of different economic strata have gained as per Table 3. This table indicates how the benefit of Rs. 31,003 was distributed amongst the individuals of various economic strata. VWL has benefited the poorest the most. This is in consonance with the philosophy of social forestry.

Villagers perception about distribution of benefits

Different beneficiaries have different perception about their gains Some feel that rafters should be supplied absolutely free and even 6(% of the price should not be charged whereas others are of the opinion that apart from fuelwood and timber, country type fruit trees like *Syzygium cumini*, *Mangifera indica*, *Emblica officinalis* and similar other trees should have been raised for providing nutrients fruits to the children of the poor. In their views, only such common property resource can provide fruits to the children of the poor in the village. Some are of the opinion that timber trees of better species like *Tectona grandis* should be raised and more quantity should be supplied. Some feel the necessity of reducing the rotation and change over to irrigated plantations. Few are very candid in their opinion that they would have never been in a position to provide facilities like shed for cattle, facilities for storing firewood, repair to their houses etc. without the help of timber from VWL. In their views, this has been a great achievement of social forestry for them.

Different people have utilized the benefits in different ways. As a rule, firewood is used locally and timber is used either for constructing new huts or repairing the old ones. Quite a good number of people specially landless feel that they would have never been in a position to provide shelter to their cattle and repair their huts but for the help from the village forest. By and large, all beneficiaries have used the extra money saved in creating permanent assets like cattle shed, storage facility for firewood etc.

Dimensions of success

The piece of land of 4 hectares, which was lying unutilized and waste has played a vital role in benefitting the community as a whole and the poor sections of society in particular. The benefits achieved from the activity can be divided into two categories namely, direct benefits and indirect benefits.

(a) *Direct benefits*

1. *Financial Viability* : Table 7 indicates that this is financially a viable activity.

The financial analysis in Table 5 indicates that the village forest activity in this village is financially quite attractive and it has earned an Internal Rate of Return (I R R) higher than 35% against the antici-

Table 6

Distribution of benefits

(Subsidies to individual beneficiaries)

Category of beneficiaries	Qty. distributed	Market price (Rs.)	Price charged (Rs.)	Benefit (Rs.)	% to total financial benefits.
Landless x	*Lops tops* 140 Qtl.	3,360	—	3,360	
	Timber 3.050 m³	52,25	3,135	2,090	
x Sub-Total FW Timber	140 Qtl. 3.050 m³	8,585	3,135	5,450	
Wages from operations	—	—	—	13,354	
Sub-total for landless				18,804	60.66 %
Marginal Farmer	*Firewood* 150 Qtl.	3,600	190 x	3,410	
	Timber 0.725 m³	1,242	745	497	
Sub-total FW Timber	150 Qtl. 0.725 m³	4,842	935	3,907	12.60 %
Small Farmers	*Firewood* 160 Qtl.	3,840	195 x	3,645	
	Timber 1.525 m³	2,613	1,568	1,045	
Sub-Total FW Timber	160 Qtl. 1.525 m³	6,453	1,763	4,690	15.13 %
Other section (Panchayat)	*Firewood* 150 Qtl.	3,600	190 x	3,410	11.00 %
	Timber 0.326 m³	480	288	192	00.61 %
Grand Total : FWfor material	605 Qtl.	14,400	575	13,825	
Timber	5.626 m³	9,560	5,736	3,824	
		23,960	6311	17,649	
Wages				13,354	
Final Total :				31,003	100.00 %

x Rounded to the nearest Rs. 5.00

Table 7

Internal Rate of Return

Year	Name of operation		Amount (Rs.)	NPV of amount at 35% rate of interest in 0 year (Rs.)
	A. *Expenditure*			
0 / 74–75	First year planting operation.		2,610	2,610
1 / 75-76	Second year maintenance of plantation.		433	313.77
2 / 76–77	Third year maintenance of plantation.		281	147.55
5 / 83-84	Final felling.		4,944	272.37
		Total	8,[illegible]68	3,343.69
	B. *Revenue*			
9 / 83-84	Final felling.		61,077	3,364.85
	Surplus/deficit		+	21.16

pated I.R.R. of 17%. The social and economic rate of interest would of course be much higher. While working out the financial rate of interest, the revenue accuring from grass, though quite high, has not been taken into account on the assumption that benefits obtained from the sale of grass would be balanced by the benefits foregone by free graziers. However, as a result of over grazing in the area foregone benfits were meagre whereas the increase in grass production was much higher by comparison.

2. *An Excellent Source of Employment to Poor* : In the absence of mechanisation and high material inputs, forestry is a highly labour intensive activity, as much, as 80% of the total cost is due to labour. Another interesting and appealing aspect of forestry activity is that even an unskilled labourer can be employed on works like trench-cum-live-hedge fencing, pitting, weeding, mulching, felling of trees, etc. and that employment is in a rural setting. These two factors imply that investment in community forestry essentially helps the poor and the real beneficiaries are the most deserving ones. Table 8 indicates the quantum of employment generated by the activity.

Table 6 shows that as many as 1625 mandays of work were created locally. This was a boon to the landless families of the village.

3. *Augmenting Free Firewood Supplies* : Like most parts of India, the poor of the village obtain their firewood free of charge from their surroundings. Previously the

Table 8

Generation of Employment by Village Forestry

Year	Name of operation	Amount spent (Rs.)	No. of mandays created
1974-75	First year operations (Plantation)	2,610	460
1974-75	Grass operation.	455	60
1975-76	Second year operations Plantation)	435	80
1975-76	Grass operation.	2,671	350
1976-77	Third year operations.	281	60
1976-77	Grass operation.	551	75
1977-78	Grass operation.	1,401	150
1983-84	Final felling.	4,950	390
Total		13,354	1625

women folk and children used to wander long distance in search of trees of common ownership and unguarded farms. However, with the supply of dead firwood from trees growing all around and from the lops and tops of trees which can not be economically exploited and taken to market, the fuel gatherers now find their task much easier and less time consuming. They can also go about with this task with more self respect than in the past.

(b) *Indirect benefits*

1. *Demonstration* : The initial planting of a four hectare Village Woodlot led to an accelerated activity of farm/social/community forestry resulting in plantations over an area of 199.60 hectares. This includes plantations over an area of 11 60 ha, 13 00 ha, 23.50 ha along canal bank, roadside and V W Ls respectively. An area of 151.50 hectares has also been planted up as farm forestry by 132 farmers by way of planting 606 million trees during the period from 1981 to 1986. Though, quite a sizeable proportion of this 199.60 ha of plantation is under farm forestry, which does not greatly increase, the supply of fuelwood and fodder needed by the poor but is meant for urban pole market; it does produce branch wood to the extent of about 15% which cannot economically be marketed by big farmers and thus essentially goes to the poor who gather it for their use. In addition, it generates employment opportunities for the poor sections of society. Most of these social forestry works are quite successful, having a survival of 80 to 85% Immediately after felling, the village forest during 1983-84, the Panchayat went ahead with replanting the area during 1984-85 with improved inputs (e.g. irrigation) and a better plantation mix of *Casuarina*, *Eucalyptus*, Bamboo and *Syzygium cumini*. Simultaneously, proposals are now a-foot to exploit the canal bank plantation of 1976-77. A situation is slowly but steadily developing in which Dhanori will soon have a tradition of annual planting and harvesting of trees. It has thus resulted in the creation of an important decentralised economic activity in a rural area, which is no mean achievement.

2. *Gains to the Community*: Apart from creating an awareness for the proper use of a common property resource, the village community on the whole gained as much as Rs. 22.935 (Rs. 5,029 from grass production, Rs 17,714 as the Panchayat's share of the final felling and a subsidy of Rs. 192.00). This was subsequently spent in creating community services like village roads (Rs. 15,029), the construction of a school building (Rs. 7,272) and kept for future use (Rs 634.00).

The farmers and labourers used to have difficulty in reaching farms, especially during rains, owing to lack of farm roads in the village. At times, they had to walk through muddy ground or water logged fields. The money from the village forest enabled the creation of a small network of foot-paths on which they could walk easily. This has also helped in the transport of farm produce and the movement of cattle. Similarly, the village had limited accommodation for students in the village school. Two classes used to sit in a single room and even the water room had to be used as a classroom. Construction of a new room has improved this situation to a considerable extent and the school has been able to enroll more children.

3. *Strengthening and Creation of Institutions*: The village community has organised itself in a Tree Growers Society (T.G S.) with 19 members and a share capital of Rs. 4,000. The T G.S. membership cuts across all economical barriers and has members from all economical strata of the community. The society undertook planting of fifty thousand and one hundred thousand trees in the years 1984-85 and 1985-86, respectively. The Tree Growers Society has also induced its members to take up Kisan Nurseries and has decided to raise 30,000 seedlings during the current year. The society will involve itself in the raising of trees on private farms as well as on community lands. The author feels that one of the most important achievements of Dhanori is the development of self confidence in villagers that they can manage vill ge forests.

Although, the poor received considerable benefits from community forestry in Dhanori, the author feels that these were not adequate. The arrangement for ensuring the flow of the benefits to the poor is also not adequate and satisfactory and there is much scope for improvement. The Government and Village Panchayat have benefited to the extent of Rs. 17,000 and Rs. 22.800 respectively. In short, it has turned out to be a typical case of State and Panchayat benefitted from a common property resource at the cost of the down trodden who had foregone their grazing rights to ensure that trees grew on them. The Government of Gujarat, has learnt a lot from this experience and in order to remedy the situation, has now very correctly decided that all the net revenue from harvested woodlots shall go to Village Panchayat only and the State shall not have anything from it. Nevertheless, it is arguable whether "helping the Village Panchayat is helping the poor."

Reasons for success of Dhanori Village Social Forestry

Dhanori can be considered as one of the very successful social forestry activity

areas in the State. Various factors that contributed to the success of this programme, can be considered under the following broad categories :

(a) *Political and Policy decisions*

Right from its inception, the programme of V.W.L was given a strong political support by the State by way of changing necessary rules for assigning gaucher lands for the purpose of V W Ls. According to Panchayat Act, which governs the use of common grazing land (C.G.L) owned by the community, no Gaucher land can be set aside for any other purpose except grazing but an exception was made in case of use of Gauchers for V.W.Ls and Government issued instructions that Gaucher lands could be used for raising V.W.Ls. without altering the ownership of such land

The State also made cent per cent finances-available to F.D. for undertaking the programme. The State also exhibited its intentions of conceding benefits to the village community by permitting free and unrestricted removal of grass from the closed plantation on headloads, free collection and disposal of fruits and M.F Ps. from V.W.Ls., and committing itself right at the inception that benefits shall be shared by the State and community on 50 : 50 basis. The share of community was further increased to 100%. Thus, the ownership of land and trees was declared to vest in the Village Panchayat. These arrangements, right at the inception, created a much desired confidence in the minds of village community that the State is committed to invest for improving productivity of their resource without any intention of taking away anything from the same.

(b) *Administrative Re-orientation*

Extension Approach : Once the political willingness was demonstrated by the State, the matching administrative measures followed as a matter of course. The impressive results of strip plantations had already convinced the State bureaucracy about the feasibility of tree raising on wastelands. The political will gave the further needed encouragement to the bureaucratic commitments, The village planning, which had a characteristics of "down-up" rather than "up-down" approach, made the programme more realistic. The planning left choice of species, type of fence, disposal of grass, establishment of nursery, mode of transport of seedling etc. to local staff and people. Planning also ensured desired results by way of providing inbuilt mechanism of treatment map which ensured proper selection of species based on geo-climatic conditions, streamlining of time schedule, realistic target setting (4 hectares), close supervision by making the scheme more officer oriented and by providing down to earth approach about protection. The realistic planning, followed by strict supervision and re-orientation of staff attitude for adopting extension approach went a long way for success of the activity. The forestry service rapidly changed over to extension service, from a regulatory one, which contributed considerably towards the success of the activity.

(c) *Local Support*

Dhanori is quite a forward looking village with literacy rate of about 35% which is far above the State average. Once convinced about the commitment of State and administration, the locals welcomed the

programme with open arms and provided a political will at local level. Several factors are responsible for this unprecedented willingness. Chiefly amongst them were the realisation amongst the people that only trees can rescue them from the devastating vagaries of regular cycles of floods and droughts experienced in the State. Their conviction that trees could be grown successfully and economically under rainfed conditions which was demonstrated by the highly motivated, dedicated and disciplined forestry service by way of raising strip plantations on hostile sites. The ways and means of forestry service convinced them and they could impose faith in such an organisation. The importance given to the involvement and participation of local people by the forestry service, was another important factor which brought about local willingness. Small and simple steps like seeking participation of people in selection of species, requests to keep the cattle away, making provisions for availability of free grass on headloads as long as area remained closed, brought about willingness of people.

(d) *Technical*

Having secured the political will and administrative commitment, the scheme was drawn on sound technical forestry practices. Chiefly amongst them were the proper selection of spp. based on geo-climatic conditions through the mechanism of treatment map which is an excellent way to avoid unsuitable spp., selection of indigeneous and fast growing spp. for planting, proper selection of site which was not very close to the habitation (1.5 km away) thereby avoiding grazing damage and clashes with local people, location of nursery in the vicinity of plantation (3 km) with adequate watering arrangement, which avoided unnecessary cost on transport and ensured quick transfer to planting site, use of optimum size of seedlings timely, planting followed by right working schedule for field operations etc. A few technical innovations like Bhur (Soil Working) making intensive and repeated soil working contributed to success in no small measure.

(e) *Institutional*

Fortunately for the programme, Dhanori has good tradition and history of running innovative co-operative movement. It ranks amongst the first few centres in India where co-operatives were formed long back. The Dhanori Vividh Sahakari Mandali was formed about three quarters of a century back during Ex-Baroda-State. Apart from this fine old age co-operative organisation, there are several co-operative institutions like Credit Co-operative Society (25 years old), Milk Co-operative Society (16 years old), Manav Davakhana (A Charitable Hospital run by Multipurpose Co-operative Society), Irrigation Co-operative Society (Introduced sometime back), Youth Club, etc. Last one to be added in this otherwise a already rich armour is a Tree Growers Co-operative Society (T.G.S. 1984). The village, has thus, been a pace setter in the co-operative movement in the area. Dhanori Village Panchayat is also working smoothly and free from any social tensions over the time. The weaker section of society has put faith in such time tested institutions which have played a major role for success of Social Forestry.

(f) *Social and Cultural*

The relation between people of different economical classes in the village are

cordial. Dhanori appears to be a closed knit, homogenous unit from the purpose of public management of common property resource. The present village head is Gulabbhai Lallubhai Halpati who belongs to economically backward class. The villagers have developed values for better mutual relations. They respect the unwritten social laws of the society. In local vernacular language, the Gaucher implies lands earmarked for feeding cow — a sacred animal Any natural resource, earmarked for such a sacred purpose, is neither tempered with nor appropriated for personal use. Consequently, the plantation area was free from any encroachment or unauthorised grazing. The social and cultural value systems have contributed their own share for success.

(g) *Financial*

State made adequate finances available for the programme and the development and extension oriented attitudes of the forest functioning ensured that financial resources, so earmarked, are utilized very productively for the benefit of the people.

(h) *Legal*

The land where plantation was raised had a well defined ownership status. The equitable distribution amongst the people was made clear by the State at the inception of the programme. Thus, the tree and land tenure were both made copiously clear for the participants. The State legally permitted use of Gaucher land for the purpose of V.W.Ls. A legal document to define responsibilities and gains of all concerned was also drawn (It could, however, not be physically executed in case of Dhanori due to administrative reasons). This clear cut legal picture went a long way in ensuring success of programme.

(i) *Natural*

The soil of the area was rich black cotton soil with an unlined irrigation canal flowing by the side of the area. This unlined canal provided required moisture by way of seepage which enabled plants to grow fast round the year.

Lessons learnt from Dhanori

Dhanori village forest, being the first one to be harvested, has brought out some of the strengths and weaknesses. It is, therefore, advisable to evaluate them with a view to improving implementation in future.

Institution Building : It became obvious that the Village Panchayat does not possess the managerial capability to harvest and market the produce. The quantity being small, it would have been possible to organise a retail sale. If the Panchayat had done so, its profit would have increased atleast by 20 to 25%.

In absence of proper felling tools e.g. racker saws, axes were used, which resulted in a wastage of about 15%. It may be desirable for the Social Forestry Organisation to purchase a few sets of improved tools which may be hired out to Village Panchayats in need of the same. In the alternative, the District Panchayats may be persuaded to do so. Another alternative in the case of villages like Dhanori where areas are available for raising more V.W.Ls. could be to purchase the necessary logging tools from the revenue of V.W Ls and make proper adjustment for depreciation of this equipment which can be replaced when worn out

Since the activity appears to be self financing, NABARD may take the initiative to help Panchayats or other Village Institutions to develop bankable projects. In the alternative, a Village Forest Committee or a T.G.S under the umbrella of the Panchayat be created to handle village forestry activities.

Organisational: The Social Forestry Organisation will have to provide for leadership in promoting institutional development at the village level for project preparation, project management and marketing. The present system does not ensure adequate local participation in planning which is of a paramount importance in an activity of this type. There is a strong case for introduction of village management plans for the activity. These activities are considered necessary. As a hind sight, it appears necessary to restructure the organisation and assign specific duties to specific functionaries, who should be accountable for the activities entrusted to them. There should not be mixing of Extension and Executive functions.

Technical Issues: For the espacement of 5 m×5 m, the MAI has worked out to be 4.12 m^3 per ha per annum. This does not appear to reflect the productivity of the site. The wider spacing was adopted largely on the consideration of availability of funds. Given adequate funds, it is possible to atleast double MAI by reducing spacing to 2 m×2 m or 2.5 m×2.5 m.

The pure plantation of Saru raised in the first rotation is not the ideal for production of small timber and firewood. Consequently, there is no surprise that 76% of material has gone outside the village for end use If this situation has to be improved, more interaction with the people is needed in selecting proper species mix. A better mix which could be suggested for this locality would be to raise Saru mixed with Katas Bamboos (Bambusa-bamboos). Saru would be harvested as pole at the end of 5th year leaving Bamboos in the area. Direct Seed sowing of spp. like *Prosopis*, *Acacia nilotica* on the trench or periphery would augment firewood supply from the area. The initial rotation of 10 years was contemplated which does not appear to be most appropriate keeping the objective of production of firewood and small timber in view. A smaller rotation of 7-8 years for small timber and a much reduced rotation for firewood needs to be tried.

Administrative: At present, the entire administration of village forests is centred around Village Panchayat which is a recognised representative body of local people. However, it is common knowledge that the under privileged have little voice in the decisions taken by the Panchayat. The case study of Dhanori illustrate this fact. The Panchayat has ignored the benefits the poor had foregone, for the success of the activity. Under the circumstances, some mechanism, may be an independent autonomous body of landless and marginal farmers, may ensure the participation of landless and marginal farmers to a greater extent. The structure and constitution of such a body is outside the scope of this article but something like "A Tree Growers' Co-operative" could be an appropriate organisation. The T.G.S. having a homogeneous memberships is likely to succeed more than the Village Panchayat which is a highly heterogeneous institution.

Financial: In the present arrangement, the initial finances came from State. The benefits are shared by all the sections of society but proportionately more by Village Panchayats specially since the flow of benefits to State has now been withdrawn. The responsibility of State to provide initial finances limits the very size of the programme. Appropriation of more benefits by Panchayats goes against the very concept of Social Forestry Co-operatives would remedy the situation. The activity could be self supporting financially having earned 35% of I.R.R. As such, it could be financed by banks. The Government say, if necessary, underwrite the loans granted for the purpose.

Author feels that the ideal arrangement to develop common property resource on a massive scale would be to involve NABARD through Tree Growers' Societies with built in tree patta arrangements for individuals and flow of technical know—how from Farest Department. A cross section of villagers and the Village Panchayat feel that the role of Forest Department in protection is irreplaceable in the present circumstances. Shri Rameshbhai Manibhai Naik—Chairman, Tree Growers' Society, Dhanori and Sarpanch—Shri Gulabbhai Halpati were can did in this statement when they remarked that without Forest Department, it would not be possible to save the trees till maturity. This has to be kept in view for future programming.

Conclusion

Dhanori experience is invaluable not only for other States of the Country but also for other developing countries of the World. The greatest problem that confronts Social Forestry Programme Implementation is :-

Appropriate Institutions
Distribution of Benefits

Dhanori village forest has provided some indications and some directions in respect of both these critical issues. Many more such case studies, in diverse agro-ecological and silvicultural regions, are needed before suitable guidelines could be developed.

Acknowledgements

The author is grateful to Shri S.A. Shah, IFS (Retd) for his guidance and inspiration. He helped me a great deal in sharpening my thoughts and articulating my views. My special thanks are due to Shri B P. Lakhani, IFS., Chief Conservator of Forests, Community Forestry Project, Gujarat State, Vadodara for his guidance and inspiration for this article. I must acknowledge a very special debt to Shri V.S. Sharma, Dy. Conservator of Forests, Navsari for collecting basic information needed for writting this article. Above all, I must also thank my junior colleagues of Navsari Division who had helped me in the field work. It is not possible to mention their names individually. However, the author acknowledges and appreciate their assistance.

SUMMARY

A 4 hectares plantation was established in 1974 on community grazing land in the village of Dhanori in Gujarat as part of the State Village Forest Scheme. ***Casuarina equisetifolia*** **was**

planted because it suited the site and the villagers wanted it. The trees were felled in 1983-84 and the distribution of benefits determined by the Village Panchayat. The Internal Rate of Return was 35%. Villagers benefitted from fuelwood and small timber for house construction and repair and from the employment generated. The success of the project led the village to organize itself into a Tree Growers Society and undertake further planting in 1984-86. The demonstrative effect of the woodlot led to 200 ha of other plantations being established in the area The poor benifited considerably from the project but if they had a greater say in the deliberations of the panchayat the benefits could have been even greater.

सामुदायिक वानिकी से होने वाले लाभ के कुछ आयाम – धनौरी ग्राम वन से हुए लाभ के प्रवाह का प्रारूपक अध्ययन

डी०पी०एस० वर्मा

सारांश

गुजरात राज्य के धनौरी ग्राम की सामुदायिक गोचारण भूमि पर राज्य ग्राम वन योजना के अंश स्वरुप 1974 में 4 हैक्टेअर का रोपवन लगाया गया। इसमें कैजुआरिना इक्वीसेटिफोलिया रोपा गया क्योंकि यही इस स्थल के लिए उपयुक्त था तथा गांव वाले भी इसे ही चाहते थे। इसके वृक्षों का 1983 – 84 में पातन कराया गया तथा उससे मिलने वाले लाभ का बंटवारा ग्राम पचायत ने विनिश्चत किया। प्रत्याय की आन्तरिक दर 35% रही। ग्रामीणों को ईंधनकाष्ठ, गृह निर्माण और उसकी मरम्मत के लिए लघुकाष्ठ और उससे मिले रोजगार का लाभ पहुँचा। परियोजना सफल होने पर ग्रामीणों ने अपने को वृक्ष उत्पादक संघ बनाकर संगठित किया और 1984–86 में वन और लगवाए। छोटे ग्राम वन के प्रदर्शन प्रभाव के फलस्वरूप इस क्षेत्र में 200 हैक्टेयर के और रोपवन लगे। गरीबों को इस परियोजना से काफी लाभ मिला परन्तु यदि पचायत के कामकाज में उनकी बात अधिक सुनी जाती तो उन्हें इससे भी कहीं अधिक लाभ प्राप्त होता।

A FOREST COVER CLASSIFICATION SYSTEM USING REMOTELY SENSED DATA

ASHBINDU SINGH*

Introduction

Forestry is a major land use second only to agriculture in India. During previous decades, acute biotic pressure on forest resources due to human and cattle population and diversion of forest land to non-forestry uses has led to severe depletion of the forestry cover. However, no quantitative assessment of forest resources at the National level has been done.

In recent years, some attempts have been made to prepare regional/national forest cover map on 1 : 1 million scale by visual interpretation of satellite imagery and estimate area under forest cover. In this connection one may refer to studies carried out by Food and Agriculture Organisations, Rome; Forest Survey of India, Dehra Dun and National Remote Sensing Agency, Hyderabad. The earth orbiting satellites of last decade have provided consistent data sers for multitemporal surveys of large areas. The prime source of data have been Landsat series of satellites launched by U.S.A., the first of which was launched in 1972. A detailed description of various remote sensing systems is given in ASP (1983) A review of application of remote sensing techniques in forestry can be found in Singh (1984 and 1987).

In majority of studies using satellite data definition of forest cover types tend to be quite variable so it is difficult to make a comparative analysis of results obtained in different studies. Ambiguity in the mapping and classification criterion, can, often cause significant differences in the result of interpretation (Singh, 1986) The problem is compounded by the absence of a uniform terminology and presence of different concepts of forest cover categories. In this paper an effort has been made to devise a forest cover classification system for use with the remote sensor data suitable for Indian conditions taking into account the nature of remotely sensed data *per se*.

Nature of Remotely Sensed data

Remote sensing is the acquisition of information about an object without being in physical contact. Aircraft and satellites are common platforms from which remotely sensed data are colleced. Earlier aerial photography used to be commonly employed in resource surveys The last decade saw the emergence of Multi-spectral Scanning Systems (MSS) as a major tool for mapping and monitoring of earth resources.

MSS observes the scene under the aircraft or satellite platform in a number of spectral wavebands of electromagenetic spectrum. Remote sensing of earth surface features is based on characteristic spectral

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response of each cover type which is recorded by multi-spectral sensor in different wavebands.

Remotely sensed data can be interpreted both manually as well as by Computer-assisted procedures. Data is collected/stored in digital form. Images are two dimensional array of numbers each representing the brightness of a small elemental area called pixel (picture element) in the image. Information extraction from remotely sensed data requires application of many different techniques (Townshend and Justice, 1981). In forestry applications classified images or thematic maps are the most important product. By *classification* we mean the process of assigning a label to pixel corresponding to an *information class*. The output of the classification process is a type of digital image, specifically, a map of classified pixels.

In preparation of thematic map using remotely sensed data, the assumption is that the multi-spectral data represents an acceptable surrogate for the attributes of features on ground and, therefore, that classes identified in the data bear some correlation to a distribution of ground cover classes (Robinove, 1981). Effective classification of remote sensing data depends upon decomposing ground cover types of interest (information classes) into sets of *spectral classes* (Swain and Davis, 1978). In theory, it is assumed that the spectral classes are indeed distinct and are in some way unique to the particular image. In practice, it is seldom true, barring for a few categories such as deep water and clouds. In general spectral domain for a typical image is a continuum. The spectral class is a non-unique partition of data in the spectral domain (Richards and Kelly, 1984). The continuous nature of spectral domain, is a result of the intrapixel mixing of cover types, along with irresolvable variability resulting from such factors as soil, vegetation and moisture contents. One may appreciate that in practical remote sensing, the recorded spectral values are due to both the reflectance properties of the ground surface area and the characterstics of the acquisition environment and sensor system. Furthermore, the ground segments evaluated for their spectral characteristics by satellite systems are not a single leaf or plant but are composed of a mixture of target and background including shadow areas, soil types and moisture regime. In fact, integration of reflective contribution due to each physical element over the spatial extent of that area yields the response characteristics of that area (pixel).

Mapping and classification criteria

A suitable classification system is required in order to assign the ground surface conditions to specific classes. Numerous vegetation classification systems have been developed to meet particular needs in various countries. At global level UNESCO (1973) 'International classification and mapping of vegetation' provides a comprehensive framework for the more important categories to be used in vegetation maps at scales of 1 : 1 million or smaller. The classification is based on ecological and physiognomic criterion. However, no consideration is given to its use combined with remote sensing data.

The most acceptable classification of Indian vegetation to date is Champion and

Seth's Classification (1968). This classification is primarily a climatic classification giving a clear picture of successional status of vegetation, ecological information and floristic composition. However, such a classification cannot be used in interpreting remotely sensed data. It can only provide general indicative information about the nature of forest types. As far as forest inventory is concerned a classification system based on the condition of physical resources in a particular locality would be a desirable option.

A new generation of land use and land cover classification system for use with remote sensing data has been developed by Anderson *et al.* (1976). However, the classification is not suitable for Indian conditions as land cover units are not only highly mixed but also highly dynamic and interactive (Tiwari, 1976). Moreover, it does not fulfil the objectives of a forest resources assessment. When remotely sensed data is principal source of data for mapping purposes, which is normally the case for large area mapping programmes, the information about land cover which can be directly derived from imagery should form the basis for a classification system. Additional information available, if any, can be superimposed/supplement land cover data. So a forest cover classification system should be designed according to the following criterion (modified from Anderson *et al.*, 1976) :

— Classification system should have categories which could be directly interpreted from imagery.

— Level of interpretation accuracy should be high (minimum 85%). Thumb rule is : Interpretation accuracy is inversly proportional to number of categories used.

— Results can be repeated by a number of interpreters using imageries of different seasons.

— Classification system should be applicable over large areas.

— Categories should be devisable into more detailed sub-categories that can be obtained from large scale imagery or ground surveys.

— Aggregation of categories must be possible.

The size of the minimum area that can be mapped depends on the scale and resolution of the imagery as well as scale of the forest map to be produced. From cartographic representation point of view and problem of legibility it is difficult to represent any area smaller than 2.5 mm on a side (Lillesand & Kieffer, 1979). The minimum size ground areas that can be mapped at the same representative scales are :

Remote Sensing Imagery	Map compilation scale	Approximate minimum size area mapped
1 : 10,00,000	1 : 10,00,000	625 ha
1 : 2,50,000	1 : 2,50,000	40 ha
1 : 50,000	1 : 50,000	1 56 ha

Parameters for classification : Remote sensing is usually concerned with characterization of plant formations in terms of stand height and crown cover. The height of the stand is considered to be the most consistent physiognomic parameter to describe formations (Raunkiar, 1934;

Kuchler, 1967). Also texture and overall spectral response of vegetation are influenced by height as well as leaf area index/crown cover. Though height of stand cannot be directly estimated on satellite imagery, often, the height causes even more differences in stand structure and shadow pattern than the crown cover alone (Howard and Schade, 1981). The distinction based on height classes are :

>7 m	Forest	(FAO 1982)
.50 cm to 7 m	shrubs	

However, these limits should be considered flexible as distinction between tree and shrubs is not always easy. In areas of Western Rajasthan and Gujarat economically important species of *Prosopis juliflora* rarely attains height of 7 m but from forestry management point of view, it can not be treated as shrub.

Second parameter of importance is Crown cover. The Crown cover classes are :

>40%	Dense Forest
10% - 40%	Open Forest
<10%	Non-Forest

When the coverage of trees is 40%, the distance between two tree crowns equals the mean radius of tree crown (UNESCO, 1973).

Apart from these two quantitative parameters, the qualitative lifeforms i.e. broadleaved and coniferous can be used as criteria for classification using remotely sensed data. On aerial photographs these characteristics can be observed directly but on satellite imagery radiance values as recorded by satellite sensors are effected by these parameters. Broadleaved and coniferous species are distinguishable because of their distinctive spectral response pattern in near-infrared wavebands.

Classification System

Forest cover classes

1. Forest

Lifeforms classes

11 Coniferous Forest

12 Broadleaved Forest

(Further sub-division may be possible such as Bamboo mixed broadleaved forest, for which three digit numerical code may be reserved).

Density classes

1 — 1 Dense Forest

1 — 2 Open Forest

2. Mangroves
3. Scrub
4. Grassland
5. Forest Plantations
6. Shifting Cultivation
7. Regrowth/Abandoned shifting cultivation
8. Non-forest

81 Water bodies

82 Others

9. Cloud and shadows

As an example :

12 — 1. Forest Broadleaved dense

i e. Dense broadleaved forest.

Definition of cover classes

(1) *Forest* : Land covered by trees (woody plant with a single well defined stem and more than 7 m height).

(2) *Mangroves* : Typically a closed evergreen forest of moderate height composed of trees specially adopted to survive on tidal mud which is permanently wet with salt water and submerged every tide (Champion & Seth, 1968).

(3) *Scrub* : Vegetation tyre, the main woody elements of which are shrubs (more than 50 cm and less than 7 m height : woody plants with multiple stems or branching near the ground).

(4) *Grassland* : Land covered by grasses and herbaceous plants.

(5) *Forestry Plantation* : Plantations raised of trees, either on forest land or non-forest land. Normally trees are planted at regular spacing due to linear nature of plantations they are discernible on high resolution imageries.

(6) *Shifting Cultivation* : Area which is under active cultivation, freshly burned or abandoned but regrowth is not more than 2 years old.

(7) *Regrowth* : Natural regeneration of plants in forested areas or area left fallow long enough after shifting cultivation for vegetation to regenerate.

(8) *Non-Forest* : Land surface devoid of vegetal cover.

(9) *Cloud and shadow* : Cloud and shadow mask the information on imagery for interpretation purposes.

Discussion

In forested areas, specially in rugged mountaineous terrain, cover types of interest are, often, not spectrally homogeneous. The complexity of cover types arises mainly from the variable mixture of various elements on the ground such as soil, grasses, regrowth and scattered trees within the limit of resolution of satellite data. This is more true for coarse resolution of Landsat MSS data. In some areas even important physiognomic units may not be spectrally separable (Singh, 1987 a).

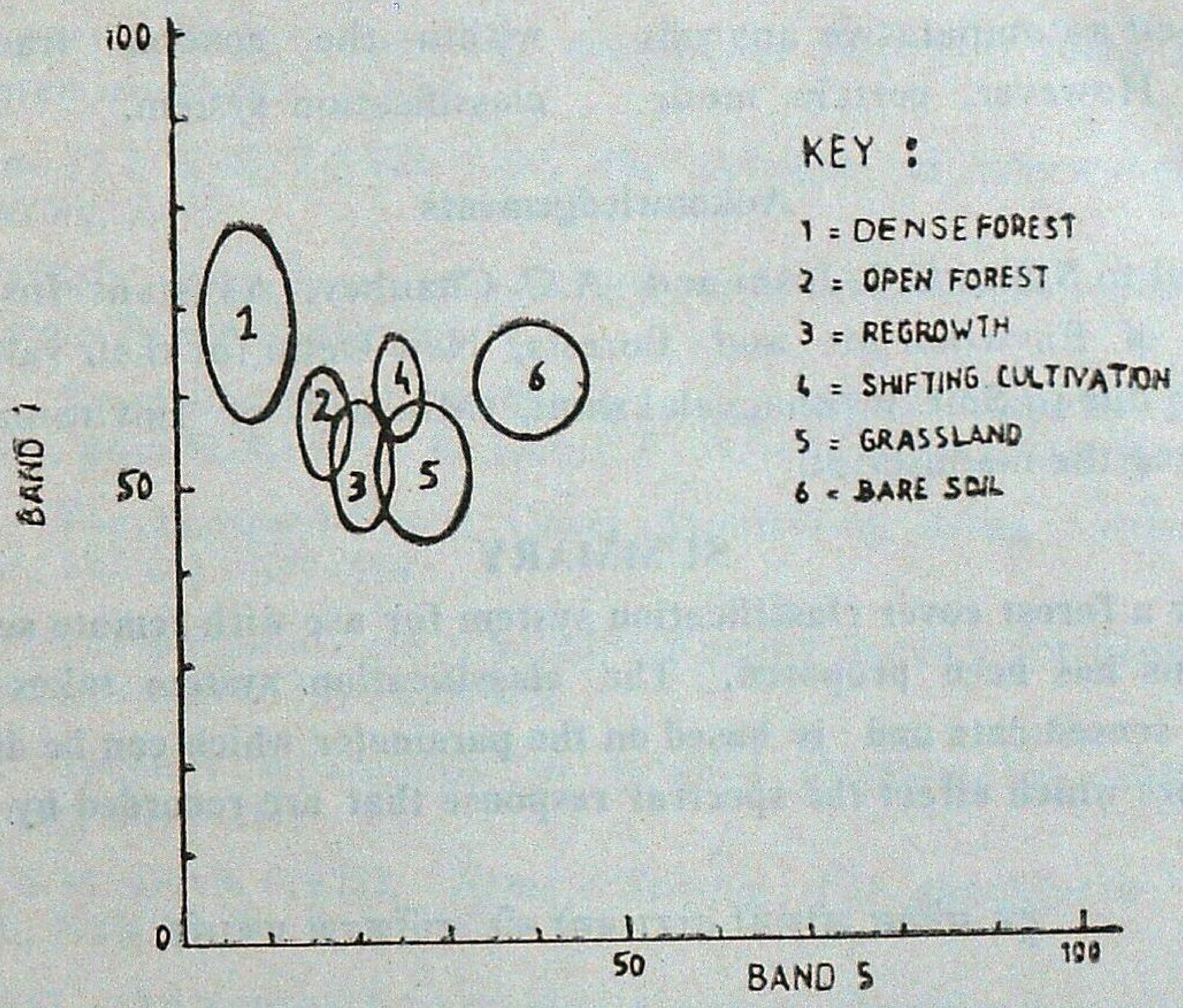
The two dimensional spectral domain in which X – axis represents band – 5 and Y – axis represents band – 7 of Landsat MSS for two areas chosen from data pertaining to north-eastern region of the country is given in Figs. 1 & 2. The center of plots for each class are located by their respective mean grey values, whereas outer periphery is defined by 1.5 X standard deviation around the mean values. This graphical representation gives an idea about the spectral separability of cover types. In Fig. 1, one finds that two density classes of forest i.e. Dense Forests and Open Forests are spectrally separable but open forest, regrowth, shifting cultivation and grassland have overlapping responses. In Fig. 2, not only two density classes of forests i.e. Dense Forests and Open Forests, but also two edaphic forest types related to different moisture conditions i.e Dense Forest and Dense Mixed Bamboo are spectrally distinct.

It may be cautioned that the proposed classification system can not necessarily yield maps of high accuracy in all regions of the country as discrimination among cover types is highly dependent on the fidelity of the spectral measurements that are recorded by the sensor. Also the information extraction from imagery depends upon several factors such as spatial resolving power of satellite system, spatial properties of the terrain being sensed, techniques being applied and certain characteristics of sensor (Townshend, 1980).

Conclusion

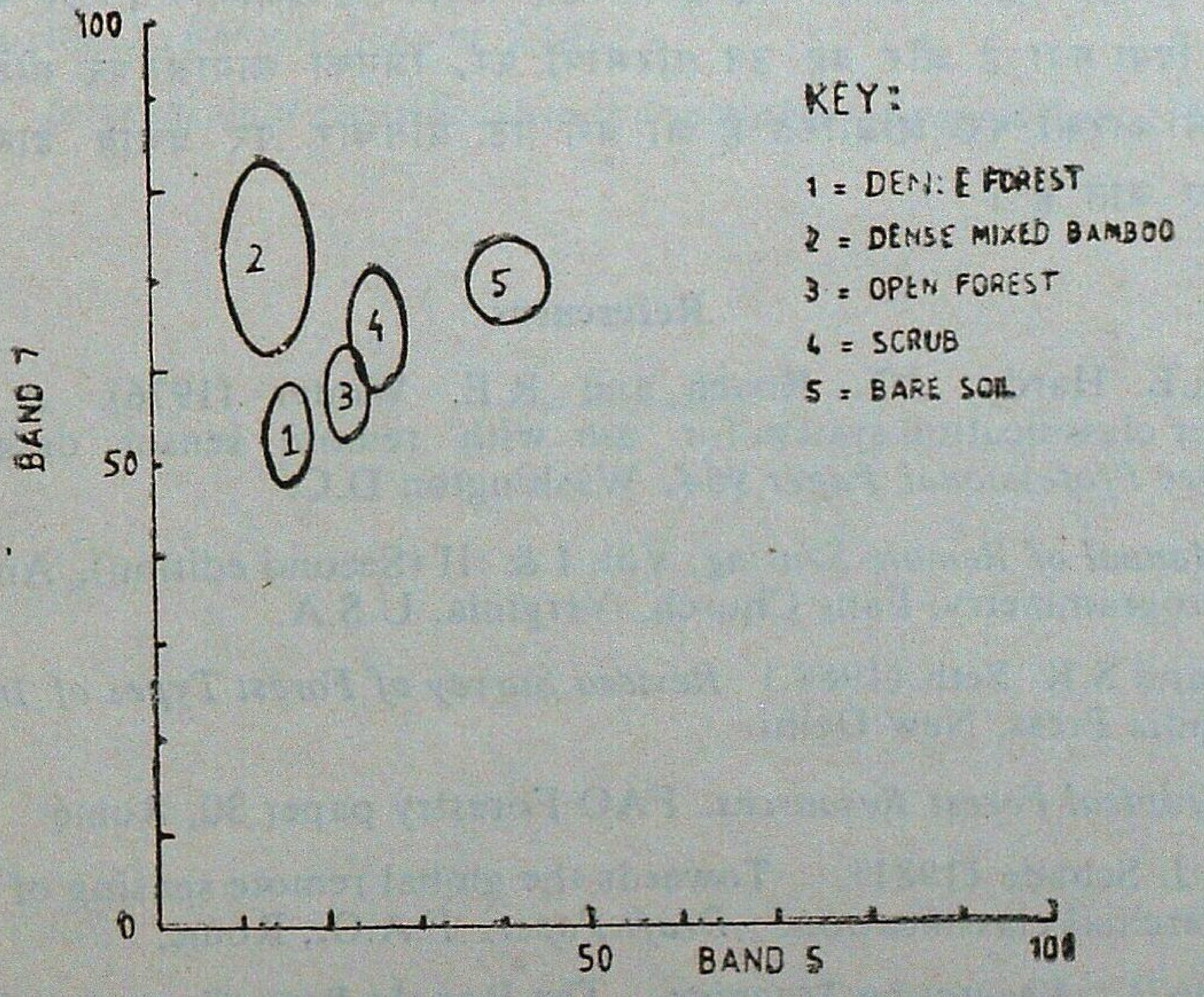
The proposed forest cover classification system should meet needs of regional/national level forest mapping and monitoring programme using remotely

Fig. 1



Overlap of forest cover classes within the feature space defined by bands 5 & 7

Fig. 2



Feature space plot of cover classes
(Source : Singh, 1987 a)

sensed data. This will help to maintain consistency among data sets obtained from different surveys and a comparative analysis will be possible. However, certain modifications may be needed to suit local terrain/cover type conditions which can be done within the general framework of the classification system.

Acknowledgements

I am grateful to S/Shri C.S. Joshi and A.C. Chaubey, Assistant Inspector General of Forests, Ministry of Environment and Forests, New Delhi for their valuable suggestions. My thanks are also due to Smt. P. Bhagyalakshmi, Ministry of Environment and Forests, New Delhi for typing the manuscript.

SUMMARY

In this paper a forest cover classification system for use with remote sensor data suitable for Indian conditions has been proposed. The classification system takes into account the nature of remotely sensed data and is based on the parameter which can be directly interpreted on imagery or factors which effect the spectral response that are recorded by the sensor.

दूर संवेदन आंकड़ों द्वारा वनों की वर्गीकरण प्रणाली

आशबिन्दु सिंह

सारांश

प्रस्तुत अभिपत्र में भारतीय दशाओं के लिए उपयुक्त दूर संवेदक आंकड़े उपयोग में लाकर वनों को वर्गों में बांटन की प्रणाली प्रस्तावित की गई है । इस वर्गीकरण प्रणाली में दूर सवेदित आंकड़ों की प्रकृति पर ध्यान दिया गया है और यह उन परिमापों पर, जिनका छायाओं पर सीधे निर्वचन किया जा सकता है अथवा उन कारकों पर आधारित है जो वर्ण पट प्रतिचार पर प्रभाव डालते हैं और संवेदक द्वारा आलेखित किए जाते हैं ।

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COMPARATIVE ASSESSMENT OF METHODS FOR ESTIMATING BIOMASS IN FOREST ECOSYSTEM

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Introduction

There has been a marked increase in the number of studies on forest biomass during the past decades with the realisation that total organic production is important instead of considering the forest a production system for stem wood. This is probably due to increasing pressure placed on our forests by the community such as demands for forest products, search for renewable source of raw materials etc. In addition to the productive role, the growing concern of well being of forest ecosystems has resulted in the appearance of numerous publications on forest biomass throughout the world (Parde, 1980) including India (Singh and Sharma, 1976; Sharma 1971; George, 1977; Negi, 1984). These studies are utilized by some researchers with a geographical stand point, relating the distribution of productivity over land surface to either climatic factor (Paterson, 1956; Leith, 1972), or the distribution of main plant community (Rodin and Bezilevich, 1965). Such studies give us a general idea of productivity over the earth while neglecting the productive relationship in any particular forest stand. On the other hand some researchers are concentrating on the pattern and processes of production within a given forest stand as a base for understanding the energy flow and circulation of nutrients in the forest ecosystem (Satoo and Madgwick, 1982). Thus, biomass studies are essential for estimating Net Primary Production (NPP), understanding nutrient cycling and energy transfer and predicting the effects of tree utilization management procedures or other disturbances on productivity and stability of forest stand.

The oil crises of 1970s have led a number of investigators to study the productivity of forests as a source of energy and chemical feed stock (Satoo and Madgwick, 1982). In India the man-made forests under Short Rotation Forestry (SRF), Social Forestry (SF), Energy Plantation (EP) and Farm Forestry (FF) programme are of vital importance as these plantations indirectly help to relieve the tremendous pressure on the managed forest. However, it is essential to understand the potential nutrient drain from these forests under the wide range of harvesting practices including conventional clear cutting as well.

For biomass estimation two distinctly separate situations can be considered. On one hand there is a typical research situation in which samples of trees and subordinate vegetation can be weighed in field. While on the other hand the stand biomass can be estimated by prediction equations based on

sampling over a wide geographical area. In the present paper, various methods of biomass estimation have been discussed and some comparisons have also been made between the results obtained by using different methods in a pure Sal forest (tropical moist deciduous forest) of East Dehra Dun Forest Division. The details of the stand are presented in Table 1.

Table 1

Details of the stand

1. Area of the sample plot (ha)			0.10
2. Age (years)			47
3. No. of trees on the plot			80
(i) Category	A	16	
(ii) ,,	B	21	
(iii) ,,	C	17	
(iv) ,,	D	14	
(v) ,,	E	12	
4. No. of trees/ha			800
(i) Category	A	160	
(ii) ,,	B	210	
(iii) ,,	C	170	
(iv) ,,	D	140	
(v) ,,	E	120	
5. Mean diameter of the crop (cm)			20.0
(i) Category	A	10.5	
(ii) ,,	B	15 0	
(iii) ,,	C	20.4	
(iv) ,,	D	24.4	
(v) ,,	E	28 9	
6. Mean height of the crop (m)			19.6
(i) Category	A	10.6	
(ii) ,,	B	15.2	
(iii) ,,	C	19 8	
(iv) ,,	D	22.2	
(v) ,,	E	23.8	
7. Basal area (m^2)/ha			25.2

Methodology

Selection of a sample plot: Generally it is not possible to measure all the trees of the forest stand, and thus sample plots are taken to represent the forest. As such there is no firm basis for deciding on a suitable plot size but the smallest side of a rectangular plot should be larger than the height of the dominant tree (Satoo and Madgwick, 1982). However, it will be possible to select a suitable plot size by trial and error method using some easily measured stand parameter such as basal area (Freese, 1961). The effect of plot size on variability of estimated weight is illustrated in Table 2 using data from a natural stand of *Shorea robusta*, all biomass components were more variable than conventional mensurational parameters of basal area, diameter (DBH) and height. It clearly indicates that at least larger or more plots should be used for the estimation of biomass. Similar results were also observed in a stand of naturally regenerated *Pinus virginiana* (Satoo and Madgwick, 1982). Increasing the plot size the variation will be substantially reduced (Table 2). Plantation would be expected to be less variable than naturally regenerated stands. Newbould (1967) suggested that sample plots in uneven aged mixed forests should be not less than 0.5 ha while in tropical rain forest the area must be 1/5 of the forest stand

Sample tree parameters: There is always a high correlation between DBH, height and weight. Thus it becomes essential to

Table 2

Variability of stand parameters as affected by plot size in natural stand of Shorea robusta

Growth parameters	Plot size				Remarks
	100 m^2	200 m^2	400 m^2	1000 m^2	
No. of trees	7	16	31	80	
Basal area (m^2)	0.2015 (20.15)	0.476 (23.8)	1.163 (29.075)	2.5188 (25.2)	
Average DBH (cm)	19.0	19.5	21.9	20.0	
Average height (m)	18.9	19.2	20.2	19.6	The biomass figures of various components in the plot of 1000 m^2 area are based on stratification by 1 cm diameter class.
Biomass (kg)					
Foliage	42.31	122.54	242.99	600.95	
Twig+ Branch	164.37	530.40	1013.41	2457.23	
Bark	219.59	550.54	1120.15	2959.79	
Bole	819.19	2020.42	4290.35	10786.88	
Total	1245.46	3223.90	6666.90	16804.85	
Biomass (t/ha)	125.00	161.00	167.00	168.00	

measure the DBH of all trees in a sample plot and heights of some of trees For weight determination, the sample trees can be selected either from the plot or outside the sample plot. Regression of height and diameter can be used to estimate the height of the remaining trees, a free hand curve may also serve the purpose. In the present study the height and diameter curve was obtained from 21 sample trees and the following regression equation has been worked out.

$$y = 4.8980 + 0.6832\,x \quad (r = 0.953) \ldots (1)$$

$$y = \text{Height (m)} \qquad x = \text{DBH (cm)}$$

Selection of sample trees : Sample trees should be of good form avoiding forked or damaged tree. One should also keep in mind that the number of the sample trees for measurement is limited, by and man-power available. Tree weight is usually closely related to the size, increasing proportionally to diameter raised to the power between 2 and 3 (Satoo and Madgwick, 1982). Stratified sampling based on DBH can reduce the number of the sample trees, however to get a valid regression model it will be more useful if there is a fair distribution of sample trees covering the entire range of diameter on the plot We should also avoid the tree growing on the edge on the forest.

Measurement of sample tree : Sample trees should be measured before felling in an identical way to those trees within sample plot for which weights are to be estimated. These trees are selected within or outside the sample plot depending upon the availability. In case of present study 19 trees of different diameters were harvested from the stand under study. To develop good regression models 18 more trees were harvested from different localities. Thus a total of 37 trees distributed over the entire diameter range from 9.1 cm to 37.1 cm were harvested.

All the tree components viz., foliage, twig (2 cm), branch (2 cm) and bole were separated immediately and their fresh weight recorded in the field. A representative sample of each tree component (100 g for foliage, twig and branch) was also taken for its oven dry weight estimation (80°C). The bole portion of sample trees was cut into 2 m or 1 m long sections for the convenience of weighting. A 5 cm wide disc was also removed from the base of each billet for the estimation of fresh and oven dry weights of bark and wood (under bark) and also for the estimation of volume (over bark and under bark) of the main bole (upto a diameter limit of 5 cm over bark).

There is a marked variation in the heights of sample trees. As the diameters of the trees increase, there is a corresponding increase in the heights also for a particular site. Thus the site effect becomes conspicuous and is reflected in better height growth for the good sites which *inter alia* depends on the stand density also.

Estimation of stand weight for sample trees : As suggested by Satoo and Madgwick (1982) the following steps are involved in estimating the stand weight :

(i) Selection of sample plot.

(ii) Measurement of limited number of dimensions on all standing trees in the plot.

(iii) In the case of research plots of

selection, detailed measurements of sample trees.

(iv) Application of values for sample trees to the remaining unit area.

There are several general categories of methods used to estimate the stand weight from sample tree data.

Mean tree technique : The method is based on the detailed measurement of one or more trees of mean dimensions. Sample tree data are converted to a land area basis by multiplying the biomass of different components by the total number of trees per unit area. In case of present study the average biomass in different components of three mean trees were used to get the biomass on unit area basis.

Stratified tree technique : This method is almost similar to the mean tree technique. The stand is stratified by different diameter classes. One or more trees are harvested from each diameter class having parameters close to the mean of the class and the biomass figures of different components of each stratum are added up to get the biomass on unit area basis.

Unit area method : This method involves the harvesting of all the trees standing on a randomly selected plot. Depending upon the size, age, diversity, availability of manpower etc., this method is too much time consuming and calls for much hard labour and therefore, seldom used in biomass studies.

Basal area proportion method : In this method a tree of mean basal area is harvested and the weight multiplied by the number of trees per unit area gives the biomass. When a tree of mean basal area is not available, several trees closest to the mean basal area are sampled and the following formula is used for biomass estimation

$$W = \Sigma\, w \frac{G}{g}$$

where W is the weight of trees on the plot, w is the sum of the weights of sample trees, G the sum of basal area of the plot and g the sum of basal area of the sample trees. A better estimate is obtained if stratification is done by the diameter and taking trees of mean basal area of each stratum (Satoo and Madgwick 1982).

Regression estimation technique : This method is also called "dimension analysis of woody plot" (Whittaker, 1961) and "allometry" (Kira and Shidei, 1967). This technique involves three steps as discussed below :

(1) trees are tallied by species and diameter at breast height,

(2) the weights of the sample trees are related to easily measured parameters (dbh, heights etc.),

(3) application of regression obtained in step (2) to step (1).

The regression equations for biomass prediction of different tree components have been obtained from 35 sample trees which are given in Table 3 (Negi, 1984).

Results and Discussion

A perusal of Table 2 indicates that the stand biomass is substantially affected by the plot size less than 200 m^2. Considering the total stand biomass the size of the plot should be around 1000 m^2 preferably a square plot of 30 m by 30 m since the variation in stand biomass becomes negli-

Table 3

Correlation coefficients (r) and prediction equations for different tree components as well as total biomass in Shorea robusta (Negi, 1984)

Dependent variables Y	Log DBH (x)		Log D^2H (x)	
	Regression equations	r	Regression equations	r
Foliage	log y= −2.28061+2.33526 log x	0.944	log y= −2.52895+0.84866 log x	0.935
Twig	log y= −2.26097+2.23036 log x	0.930	log y= −2.48657+0.80640 log x	0.920
Branch	log y= −2.42358+2.86678 log x	0.936	log y= −2.67889+1 02741 log x	0.916
Bark	log y= −1.40374+2.25082 log x	0.954	log y= −1.78422+0 85390 log x	0.991
Bole	log y= −1.95385+3.10398 log x	0.986	log y= −2 34087+1.14144 log x	0.993
Total	N.D.		log y= −1.78825+1.04848 log x	0.994
Root	log y= −1.72010+2.65696 log x	0.977	log y= −1 88750+0.93460 log x	0.981
Total	N.D.		log y= −1.54325+1.01781 log x	0.995

N.D. = Not determined.

gible. The reliability of the estimates depend on the sample trees felld, therefore, the judicious selection of sample trees is a first requirement. Forked and abnormal trees should be avoided and the trees on the edge of the forest should not be included A comparison of biomass estimated by using various methods has been made in Table 4. Out of the five methods used, the mean tree technique and the basal area proportion method gave six to eight per cent under-estimates of the total biomass of 166 t/ha estimated by stratified tree technique. Results from the test plots reported by Satoo and Madgwick (1982) indicate that the mean tree method can give large under estimates of canopy weights, however, estimates based on the several trees closest to mean basal area generally gave results within ten per cent of actual plot values. The frequency distribution of diameter classes may not necessarily be symmetrical about the mean and the asymmetrical distribution may result in the under-estimates or over estimates of the biomass. In the present case, the best results have been obtained by regression methods after the stratified tree technique. Since there is a good correlation between the tree weight and the linear size (dbh, heights etc.) the regression techniques are most widely used and the only methods for estimating biomass of the stand where no direct sampling has been undertaken though the component weights particularly the leaf is subject to large variation(Satoo and Madgwick, 1982). In the present study the regression estimates of foliage weight as compared to that of stratified technique are about 16 per cent under-estimations while the (twig + branch) estimates are within 6 to 8 per cent. The stratified tree technique gives good and reliable estimates if sufficient number of trees are included in each stratum, the regression technique is the next choice where destructive sampling is not possible.

Table 4

Comparison of biomass (t/ha) estimates obtained by using various methods in Shorea robusta stand

Components	Mean tree technique	Stratified technique	Basal area proportion method	Regression method	
				Log D^2H	Log D
Foliage	5.3	5.7	4.5	4.8	4.7
Twig+Branch	15.5	23.5	20.1	22.1	21.6
Bark	27.6	27.2	24.7	47.7	27 4
Bole	107.6	109.6	104.0	112.0	112.3
Total	156.0	166.0	153.3	166.6	166.0

Conclusion

The stratified tree technique is undoubtedly the best method but it is time consuming and expensive, therefore, there is a need to develop estimating equations of wide applicability so that reliable esiimates of stand biomass may be obtained without a recourse to the laborious destructive sampling.

SUMMARY

The paper describes various methods of biomass estimation in forest ecosystems with their limitations and applicability. Some comparisons have also been made between the conventional stratified tree techniques and other methods and the regression technique has been found to be satisfactory for wider application or where the destructive sampling is not desirable.

वन परिस्थिति सहतियों में जैवपुंज का अनुमान लगाने की रीतियों का तुलनात्मक आकलन

जे०डी०एस० नेगी, एस०सी० शर्मा व डी०सी० शर्मा

सारांश

इस अभिपत्र में वन परिस्थिति सहतियों के जैवपुंज का अनुमान लगाने की विभिन्न रीतियों का उनकी सीमाओं और प्रयोज्यता समझाते हुए वर्णन दिया गया है। पारम्परिक स्तृत वृक्ष प्रविधियों और अन्य रीतियों में तुलना भी की गई है तथा विस्तार से अथवा ऐसी जगह जहाँ विनाशक नमूने लेना वांछित नहीं होता, लागू करने के लिए प्रतीपायन प्रविधि भी संतोषप्रद रही है।

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ON THE STRUCTURE AND IDENTIFICATION OF *EUCALYPTUS* SPECIES

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Introduction

By virtue of their adaptability to grow under diverse climatic conditions, eucalypts are being planted in many parts of the world. In India, large scale plantations of different species are being raised in various states to meet the growing demand for pulp and fuelwood Some of the species are also suitable for poles, fence posts, crates, packing cases, agricultural implements, carts, tool handles, wall panelling, overhead power and telecommunication lines etc. (Shukla and Rajput, 1983; Jaitely *et al.*, 1983). The essential oil obtained from the leaves and flowers of *Eucalyptus citriodora* Hook. and *E. globulus* Labill. is of great value in medicines and perfumery.

Owing to the increasing demand of *Eucalyptus* for different end uses, the need is felt for identification of individual species from their anatomical structure. Dadswell (1972) in his comprehensive study of eucalypts separated species of series *Corymbosae* (Peltatae) of section *Macranthera* of Blakely (1955) from the rest of the species on the basis of vessel arrangement and parenchyma distribution. Purkayastha (1982), following Dadswell, categorised the nine *Eucalyptus* species growing in India in two broad groups. With a view to distinguishing the nine species individually, the present study on detailed microscopic features with special reference to ultrastructural studies of vestured pits, was undertaken.

Material and Methods

The wood samples available for study in the Xylarium of this Institute alongwith accession number and locality are given in Table I. Small wood blocks were taken out from the samples and cross, radial and tangential sections were prepared following the usual laboratory procedure.

Mean frequency of vessels and percentage of solitary and radial multiples were determined from cross sections at five random positions. Average number of rays per mm and number of bi-and tri-seriate rays were also determined at five different positions in tangential sections. Crystals were observed in radial sections.

For studying vesture morphology of vessel and fibre pits under SEM, 100 μm thick radial and tangential sections were cut, oven-dried and mounted on aluminium stubs The sections were coated with Gold/Palladium and observed under the Scanning Electron Microscope at a tilt angle of 45°. The terms used for describing the different vesture forms, i.e. coralloid and dendroid implies vestures attached to all parts of pit chamber and vestures bordering the pit aperture respectively. The different forms of

Table

Diagnostic Microscopic features

Species	Acc. No./ Locality	Vessels				
		Max. tangential dia (μm)	Ave frequency (per mm²).	Radial multiples common	Oblique groups common	Diffuse
E. calophylla R. Br. ex Lindl.	4092, Nilgiris, Tamil Nadu	192	7-11	+	–	–
E. citriodora Hook.	8180, Dehra Dun, Uttar Pradesh	192	15	+	–	+
E. maculata Hook.	8071, Thana, Maharashtra	176	16-21	+	–	+
E. camaldulensis Dehn.	8197, Dehra Dun, Uttar Pradesh	160	10	–	+	+
E. tereticornis Sm.	8181, Dehra Dun, Uttar Pradesh	160	10	–	+	+
E torelliana F.V.M.	8163, Dehra Dun, Uttar Pradesh	160	5-10	–	+	+
E. globulus Labill.	1097	135	9-11	–	+	+
	1094, Nilgiris, Tamil Nadu	128	5-11	–	+	+
E. grandis (Hill) Maiden	8178, Dehra Dun, Uttar Pradesh	176	9-14	–	+	+
E. piperita Sm.	4048, Nilgiris, Tamil Nadu	105	12-17	–	+	+

+ indicates presence – indicates absence

1

of Eucalyptus species

Parenchyma					Rays			Fibres	
Diffuse in aggregates	Vasicentric	Confluent	Banded	Crystals	No. of rays (per mm)	No. of biseriates (per mm)	No. of tri-seriates (per mm)	Pits conspicuous on radial wall	Pits conspicuous on tangential wall
–	+	+	+	+	7–10	2–3	–	±	±
+	+	–	–	+	11–13	5–7	–	+	±
+	+	+	–	÷	13–15	1–3	–	+	±
+	+	–	–	–	13–17	1–3	–	+	+
+	+	+	–	+	11–15	1–2	–	+	+
+	+	–	–	–	15–20	6–9	1–3	+	+
–	+	–	–	–	13–15	5–6	–	+	+
–	+	–	–	–	13–15	5–6	2	+	+
–	+	–	–	–	12	–	–	+	+
–	+	–	–	–	12–18	2–6	–	+	+

Table 2

Group	Anatomical Features Dadswell, 1972 Purkayastha, 1982	Species	Vesture Morphology	
			Vessel Pit	Fibre Pit
	(*Corymbosae* series of section *Macranthera*)			
I	Vessels commonly in short or long radial multiples and clusters, parenchyma vasicentric to aliform-confluent, also sometimes diffuse-in-aggregates inter-fibre pits simple to indistinctly bordered.	*E. calophylla*	Coralloid*-uneven and also Dendroid extending	Simple to feebly vestured
		E. citriodora	Dendroid**-warty	Dendroid-warty
		E. maculata	Coralloid-uneven	Simple
	(Series excluding *Corymbosae*)			
II	Vessels mostly solitary showing varying degrees of oblique arrangement, fibre pits are with conspicuous border both on radial and tangential walls.			
	a. Parenchyma vasicentric and diffuse to diffuse-in-aggregates.	*E. camaldulensis*	Coralloid-even, fine	Dendroid-warty
		E. tereticornis	Coralloid-even, fine	Feebly vestured
		E. torelliana	Coralloid-even, fine	Coralloid-warty
	b. Parenchyma scanty vasicentric and diffuse.	*E. globulus*	Coralloid-warty to Dendroid extending	Feebly vestured
		E. grandis	Coralloid-even, fine	Dendroid-warty
		E. piperita	Coralloid-warty	Dendroid-warty

* Coralloid — vestures attached to all parts of pit chamber

** Dendroid — vestures bordering the pit aperture

Plate 1

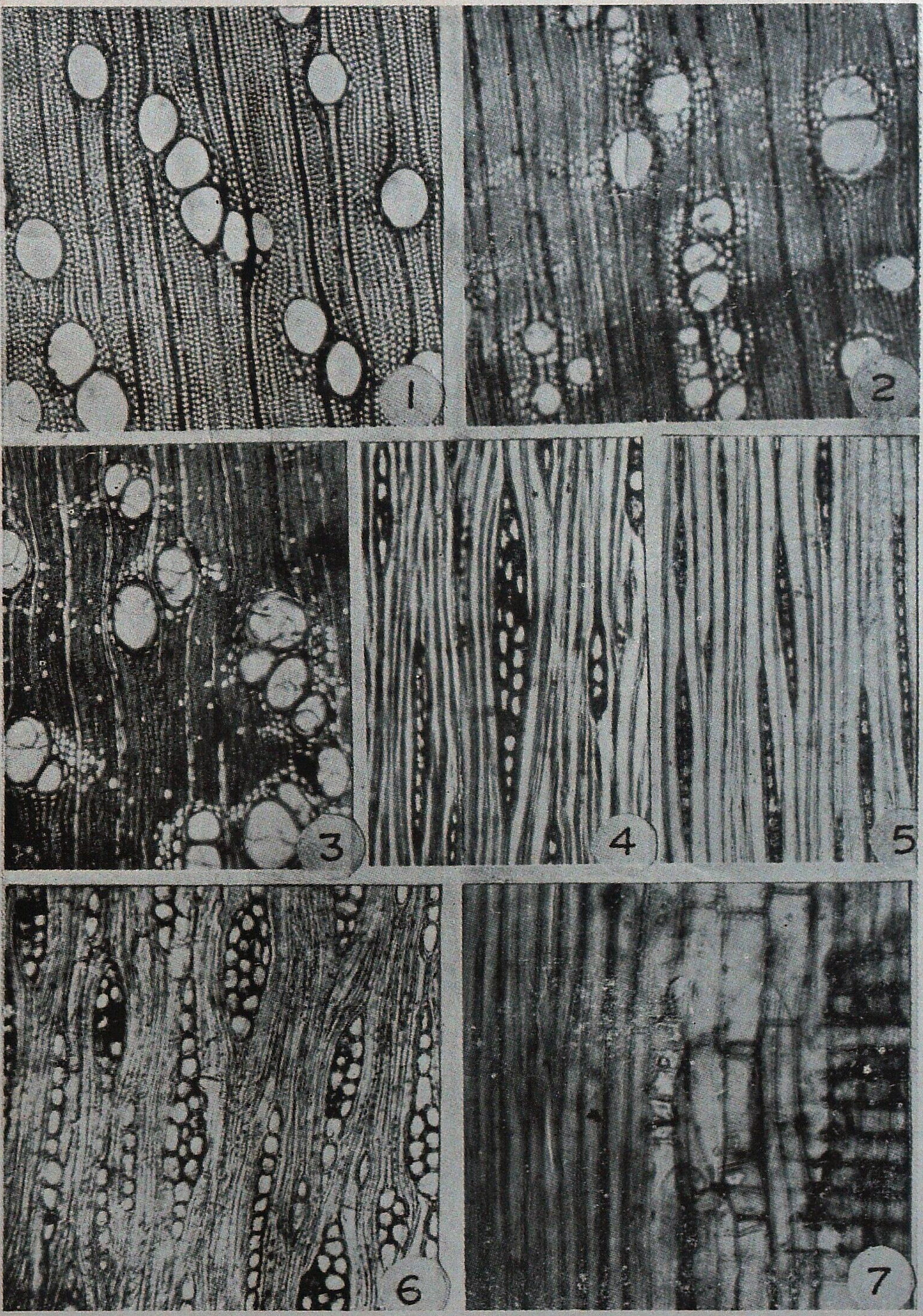
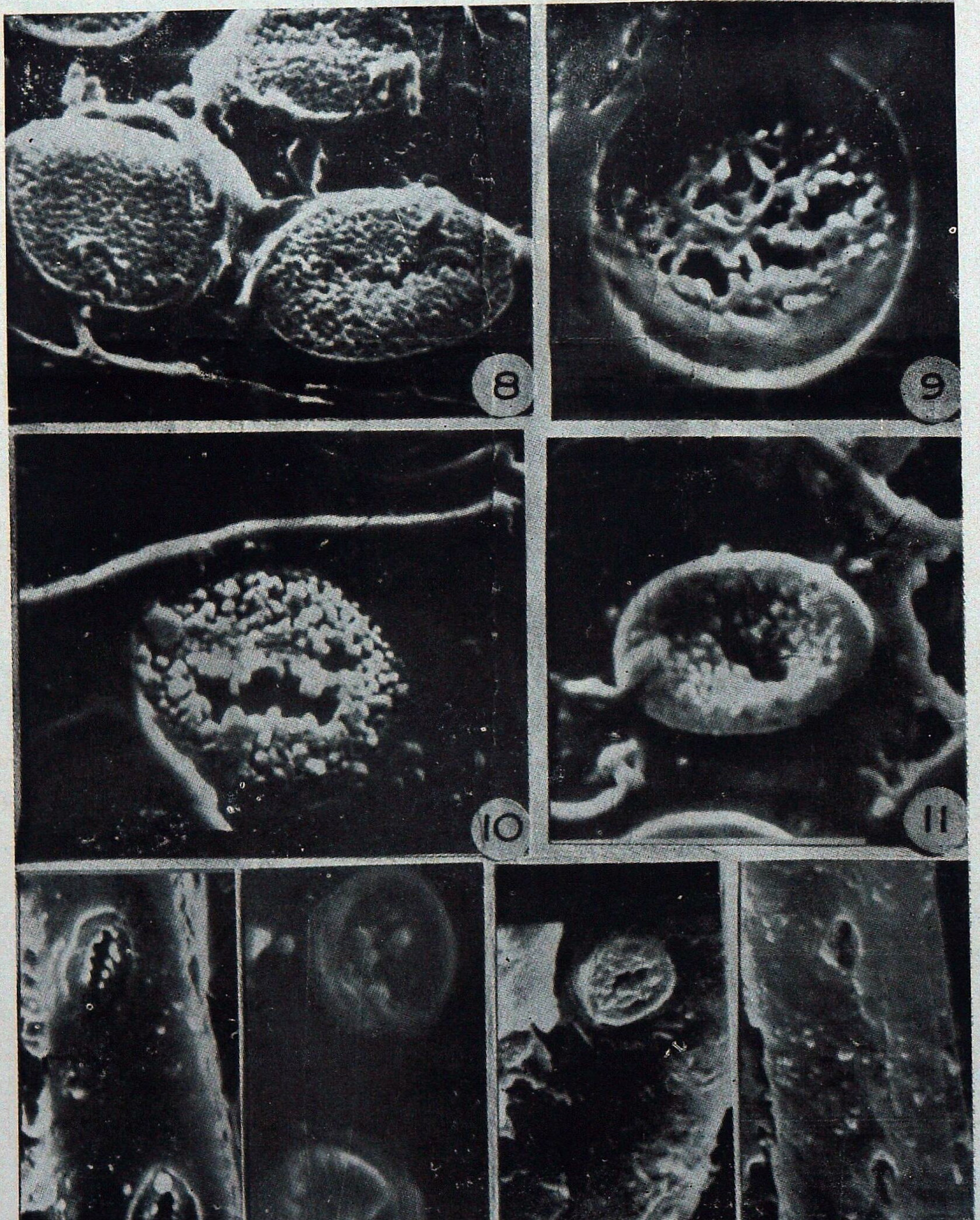


Plate 2



Explanation of Plates

Plate 1

Fig. 1. Cross Section—*E. grandis* (Hill) Maiden showing oblique arrangement of solitary vessels and vasicentric parenchyma × 60.

Fig. 2. Cross Section—*E. maculata* Hook. showing radial arrangement of vessels and clusters and vasicentric to confluent and diffuse parenchyma × 60.

Fig. 3. Cross Section—*E. camaldulensis* Dehn. × 60.

Fig. 4. Tangential Section—*E. globulus* Labill × 60.

Fis. 5. Tangential Section—*E. grandis* (Hill) Maiden showing uniseriate rays × 60.

Fig. 6 Tangential Section—*E. torelliana* F.V.M. showing 1-4 seriate rays × 60.

Fig 7. Radial Section—*E. maculata* Hook. showing chambered crystals in parenchyma × 60.

Plate 2

Figs. 8-15. Vesture forms as observed under SEM × 5000.

Fig. 8. *E. torelliana* F.V.M.—Vessel pits coralloid-even.

Fig. 9. *E. calophylla* R. Br. ex Lindl.—Vessel pits coralloid-uneven.

Fig. 10. *E. globulus* Labill—Vessel pits coralloid-warty.

Fig. 11. *E. piperita* Sm.—Vessel pits coralloid-warty.

Fig. 12 *E. piperita* Sm.—Fibre pits dendroid-warty.

Fig. 13. *E. citriodora* Hook.—Fibre pits dendroid-warty.

Fig. 14 *E. torelliana* F.V.M.—Fibre pits coralloid-warty.

Fig. 15. *E. maculata* Hook.—Fibre pits simple.

'Coralloid' and 'dendroid' described are on the basis of the finding of Bisen and Laxmi Chauhan (unpublished).

Results and Discussion

The anatomical features studied are presented in Table 1. Vesture morphology of the vessel and fibre pits as observed under SEM are given in Table 2.

It is apparent that most of the anatomical observations of the present study are in agreement with those of Dadswell (1972) except the frequency and size of vessels may be due to factors like environment and locality. While all the nine species can be classified into two broad groups based on percentage of solitary vessels and types of parenchyma as has been done by Purkayastha (1982), further separation of the species can easily be made by difference in the vesture morphology of vessel and the fibre pits, as given in Table 2.

It will be observed from Plate 1 that vessels are mostly in radial multiples and clusters and parenchyma is abundant, ranging from vasicentric to confluent and diffuse and sometimes aggregates in *E. maculata* Hook (Fig. 2) belonging to *Corymbosae* (Peltatae) series of section *Macranthera* of Blakely (1955). *E. grandis* (Hill) maiden belonging to series other than *Corymbosae* (Peltatae) has mostly solitary vessels, aligned in more or less oblique groups, parenchyma-vasicentric and diffuse (Fig. 1). The rays are generally uniseriate (Fig. 5) with biseriation in the middle portion, but in *E globulus* Labill. and *E. torelliana* F.V.M , the rays have been observed upto 3-4 seriate (Figs. 4 and 6). The crystals in parenchyma have been found to vary in their occurrence in different species. While they are present in *E. calophylla* R Br. ex Londl. *E. citriodora* Hook., *E. maculata* Hook (Fig. 7) and *E. tereticornis* Sm., they are absent or rare in *E. camaldulensis* Dehn. *E. torelliana, E. globulus* Labill., *E. grandis* and *E. piperita* Sm. Vasicentric tracheids are present in all the species.

The observations in the vesture morphology of intervessel and inter-fibre pitting as given in Table 2 are illustrated in Plate 2. The vessel pits of *E. camaldulensis, E. grandis, E. tereticornis* and *E. torelliana* (Fig. 8) are coralloid-even (fine) while those of *E. calophylla* and *E. maculata* (Fig. 9) are coralloid-uneven. The vessel pits of *E. globulus* and *E. piperita* are coralloid-warty (Figs 10 & 11) and only those of *E. citriodora* are dendroid-warty. The variation in the morphology of fibre pits is illustrated in Figs. 12-15.

The results obtained indicate the possibility of distinguishing woods of the 9 *Eucalyptus* species growing in India.

Acknowledgemants

Grateful acknowledgements are due to Shri S.S. Bisen, SRO Wood Anatomy Branch, FRI & Colleges for technical guidance in SEM studies. Thanks are also due to Shri P.K. Sharma for photographic assistance.

SUMMARY

The wood structure of nine species of *Eucalyptus* have been studied in detail both under light and scanning electron microscope. They have been distinguished on the basis of various anatomical characters viz. vessel and parenchyma distribution, presence or absence of crystals in parenchyma and percentage of tri-seriate rays, and vestured pit morphology. Though microscopic features do help to some extent in the identification, ultrastructure of vestured pits of vessels and fibres have been found more useful in distinguishing different species studied.

युकेलिप्टस की जातियों की संरचना और अभिज्ञान सबन्धी कुछ विचार

एस०पी० अग्रवाल व लक्ष्मी चौहान

सारांश

युकेलिप्टस की नौ जातियों की काष्ठ संरचना का प्रकाश और अन्वनुलोकी इलैक्ट्रान सूक्ष्मदर्शी से विस्तारपूर्वक अध्ययन किया गया। विभिन्न शारीर विशेषताओं के आधार पर अर्थात् वाहिनी और जीवितक कोशाओं का वितरण, जीवितक कोशाओं में स्फट (रवों) का होना अथवा उनका न होना एवं त्रि-श्रेणिक रश्मियों का प्रतिशत तथा वैस्ट्यूर गर्त रचना के आधार पर उनकी पहचान की गई है। सूक्ष्मदर्शी प्रदर्शित लक्षणों से कुछ सीमा तक उनकी पहचान करने में सहायता तो मिलती है किन्तु वाहिनियों के वेस्ट्यूर गर्तों की अतिसंरचना और तन्तु (रेशे) अधीत विभिन्न जातियों को अलग-अलग पहचानने में अधिक उपयोगी सिद्ध हुए हैं।

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EPIDEMIC OF SAL HEART-WOOD BORER *HOPLOCERAMBYX SPINICORNIS* NEWM. (COLEOPTERA : CERAMBYCIDAE) AND ITS CONTROL IN PACHMARI, MADHYA PRADESH

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Introduction

Epidemics of Sal heart-wood borer have been reported by various authors from many Sal forests in the country (Atkinson, 1926; Muir, 1929; Beeson and Chatterjee, 1925; Beeson, 1941; Roonwal, 1952; Mathur, 1962; Chatterjee and Thapa, 1964, 1970; Singh, *et al.*, 1977; Singh and Mishra, 1981). There is however no mention of an epidemic in Pachmari range in the working plan of Hoshangabad Forest Division (Jangely, 1965). In 1976, the Conservator of Forests, Hoshangabad Circle of Madhya Pradesh for the first time reported Sal heart-wood borer, *Hoplocerambyx spinicornis*, as causing considerable damage in Pachmari hills. It appears that no serious note was taken of that report, as no efforts were made to control the epidemic However, later in 1978-79 when the mortality of Sal increased considerably and threatened the very existance of Sal in the locality, action was initiated to check the epidemic. Pachmari is a hill resort and its Sal forest has great aesthetic and recreational value. The Sal heart-wood borer attack is disfiguring Pachmari, by killing Sal trees, which Pachmari could ill afford. Realising the gravity of the situation, the forest department made an all out effort to save Pachmari Sal from the depredations of the Sal heart-wood borer. The pest situation was evaluated and control operations were carried out from 1979-1982 to save the Sal of Pachmari from the ravages of heart-wood borer.

Materials and Methods

The studies were carried out in the Sal forests of Pachmari Range of Hoshangabad Forest Division, Madhya Pradesh. Sal of Pachmari hill ranges lie on the westernmost limit of its distribution. The Pachmari Sal forest is a reserve forest, where no silvicultural operations are carried out. The forest is of uneven composition where all age groups of the species were represented, with girth ranging from 20 cm to 180 cm. Trees in the girth class 46-60 cm, 61-90 cm and 91-120 cm constitute the major constituents of the crop composition. The associates of Sal in the area are *Terminalia tomentosa*, *Diospyros melanoxylon*, *Madhuca latifolia*, *Soymida febrifuga*, *Buchanania lanzan*, *Adina cordifolia*, *Boswellia serrata*, *Pterocarpus marsupium*, *Butea monosperma*, *Gardenia latifolia*, *Ziziphus xylopyra*, etc.

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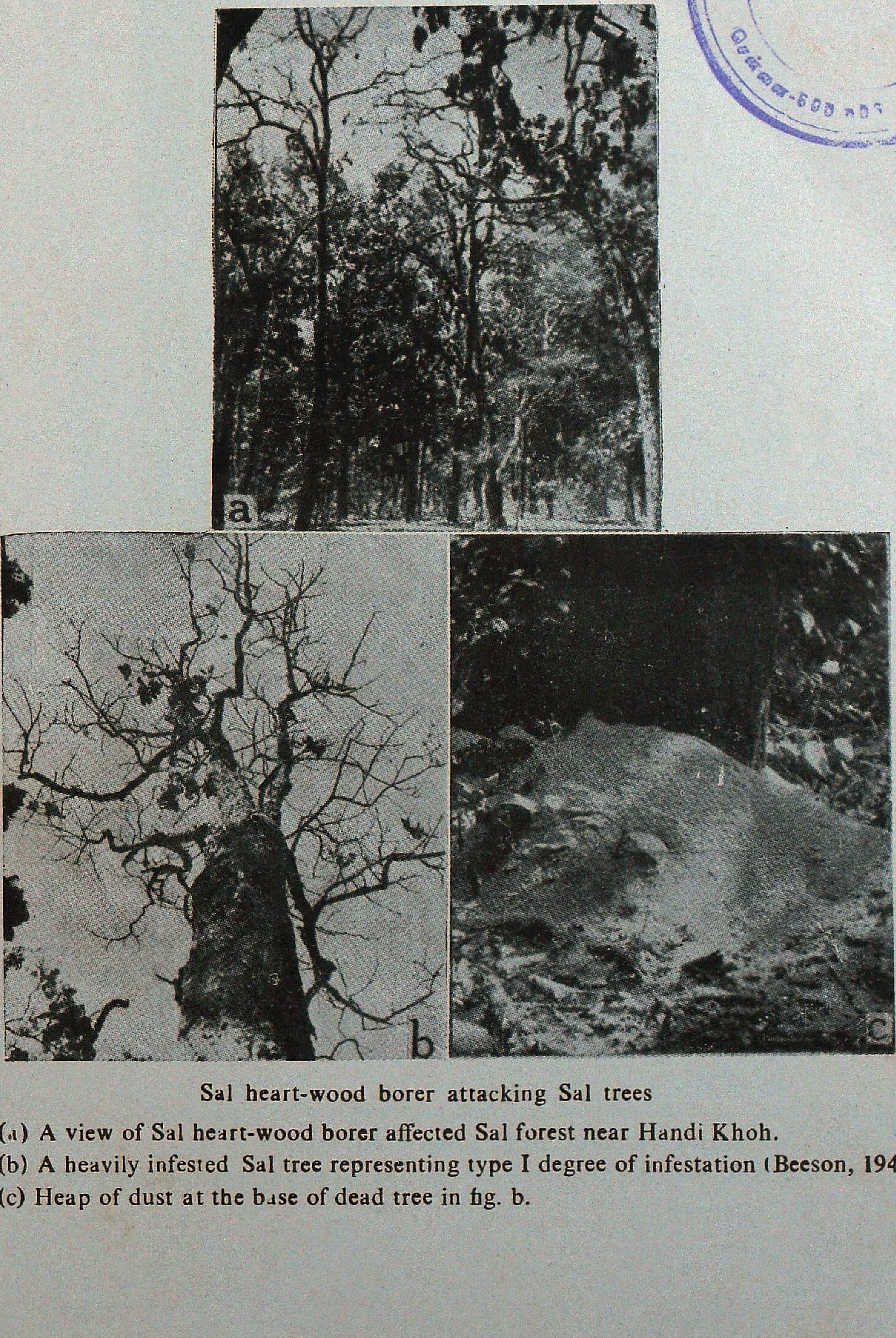
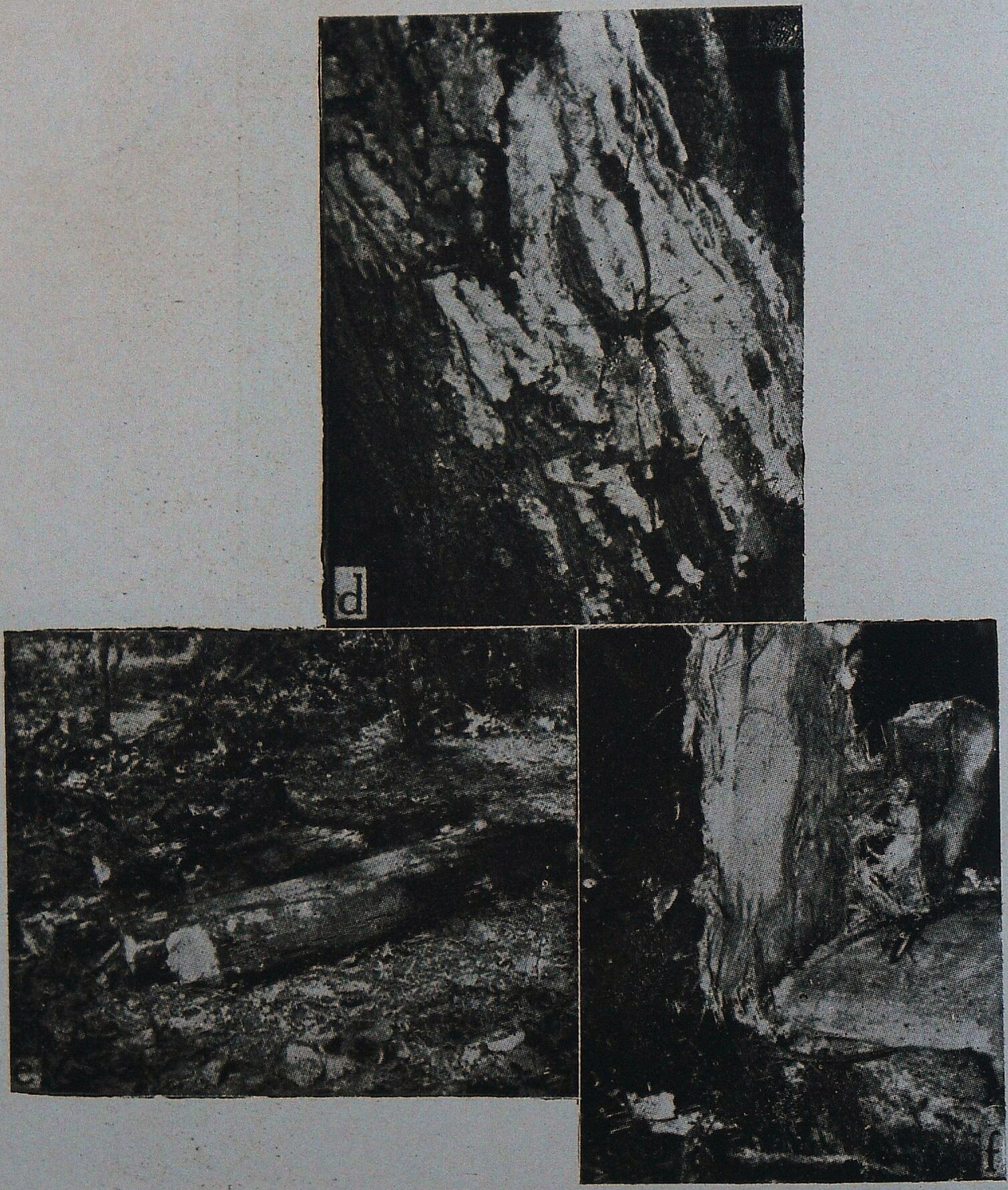
Plate 1 (a–c)



Sal heart-wood borer attacking Sal trees

Figs (a) A view of Sal heart-wood borer affected Sal forest near Handi Khoh.
(b) A heavily infested Sal tree representing type I degree of infestation (Beeson, 1941).
(c) Heap of dust at the base of dead tree in fig. b.

Plate 1 (d-f)

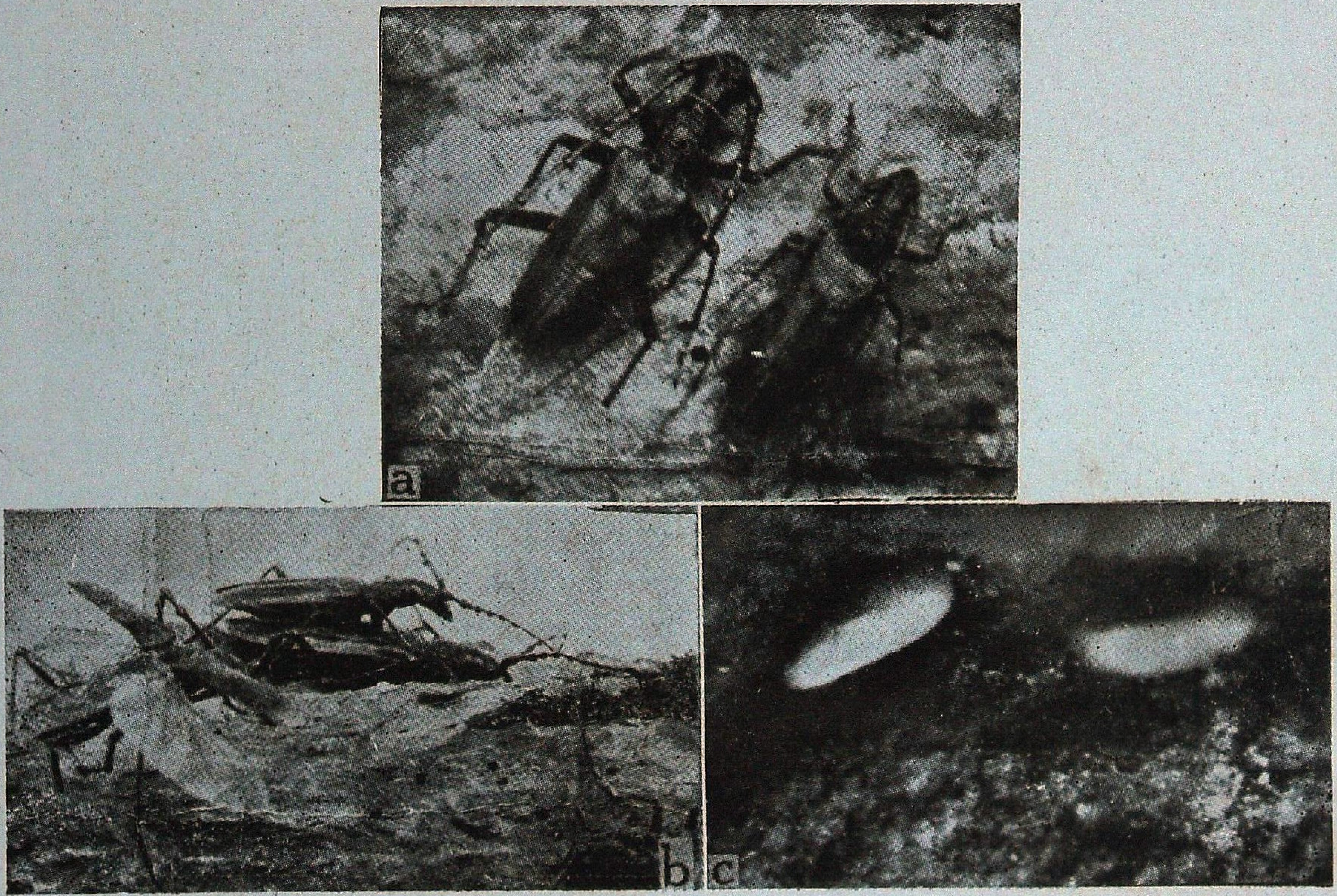


Figs. (d) Dried ral of standing *sal* tree with two beetles of *H. spinicornis*.

(e) A Sal heart-wood borer catching trap of Sal logs.

(f) The bark lifted from the end of the log to show beetles inside sheltering/feeding on oozing sap.

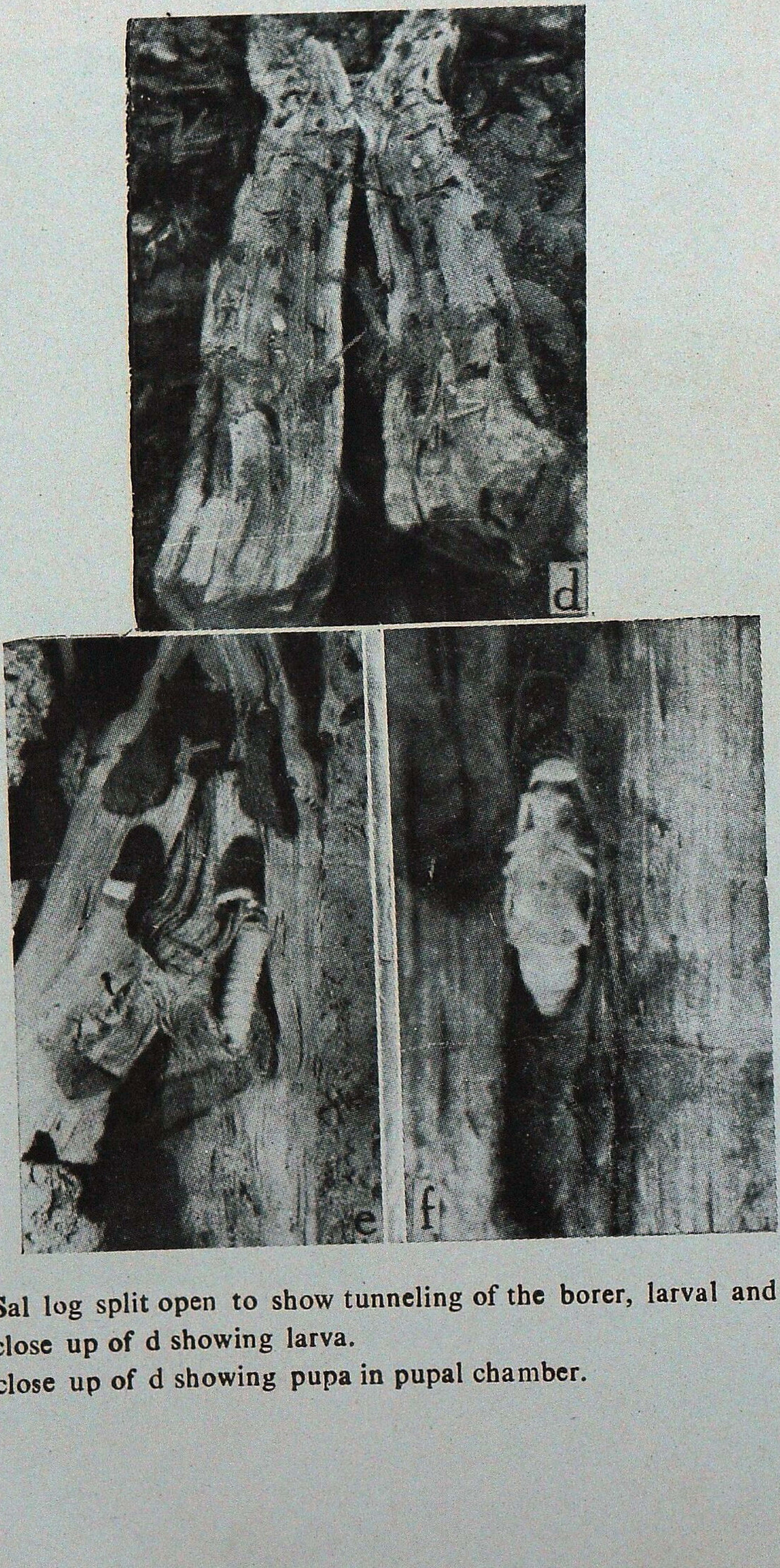
Plate 2 (a–c)



Sal heart-wood borer attacked Sal trees
and Beetles flocking to trap logs.

Figs. (a) Male and female beetles of Sal heart-wood borer on a log.
(b) A pair of mating beetles and a male beetle about to fly.
(c) Two eggs of Sal heart-wood borer in the crevices of bark.

Plate 2 (d–f)



Figs. (d) A Sal log split open to show tunneling of the borer, larval and pupal stages.
(e) A close up of d showing larva.
(f) A close up of d showing pupa in pupal chamber.

The Sal heart-wood borer sample surveys were carried out in different campartments by taking a sample plot along a nala, ridge or a road. Healthy, attacked and dead trees were enumerated and their girth recorded. Trees which were silviculturally unsound or had an attack of the borer but were green were selected for the preparation of traps in the rainy season. Heavily attacked trees (Plate 1, figs /a, b & c and Plate 2, fig. d) were felled and removed from the forest. From 1979 onw. rds the assessment of borer attack was carried out every year after the monsoon, exccpt in 1979 when a pre-monsoon survey was also undertaken and with the onset of monsoon trap tree operations were carried out. For the preparation of traps Sal trees selected for the purpose were felled and about 3 metre long logs were prepared (Plate 1, fig. e). Bark at the both ends of such logs was beaten up with a hammer or with the back of an axe so as to loosen the bark. Beetles of the borer take shelter underneath loose bark and drank fresh oozing sap (Plate 1, fig. f). After 7-8 days this loosened bark was cut-off and fresh bark about 30 cm, was beaten again at both the ends for fresh exudation of sap and shelter for the beetles. The beetles were collected regularly from each trap in the morning and evening A trap continued functioning for about 30 days, after which it was replaced by a fresh trap depending upon the catch of the beetles. Additional traps were laid in severely attacked compartments. Beeson (1941) and Chatterjee and Thapa (1964) have described the trap tree operation in detail.

Results and Discussion

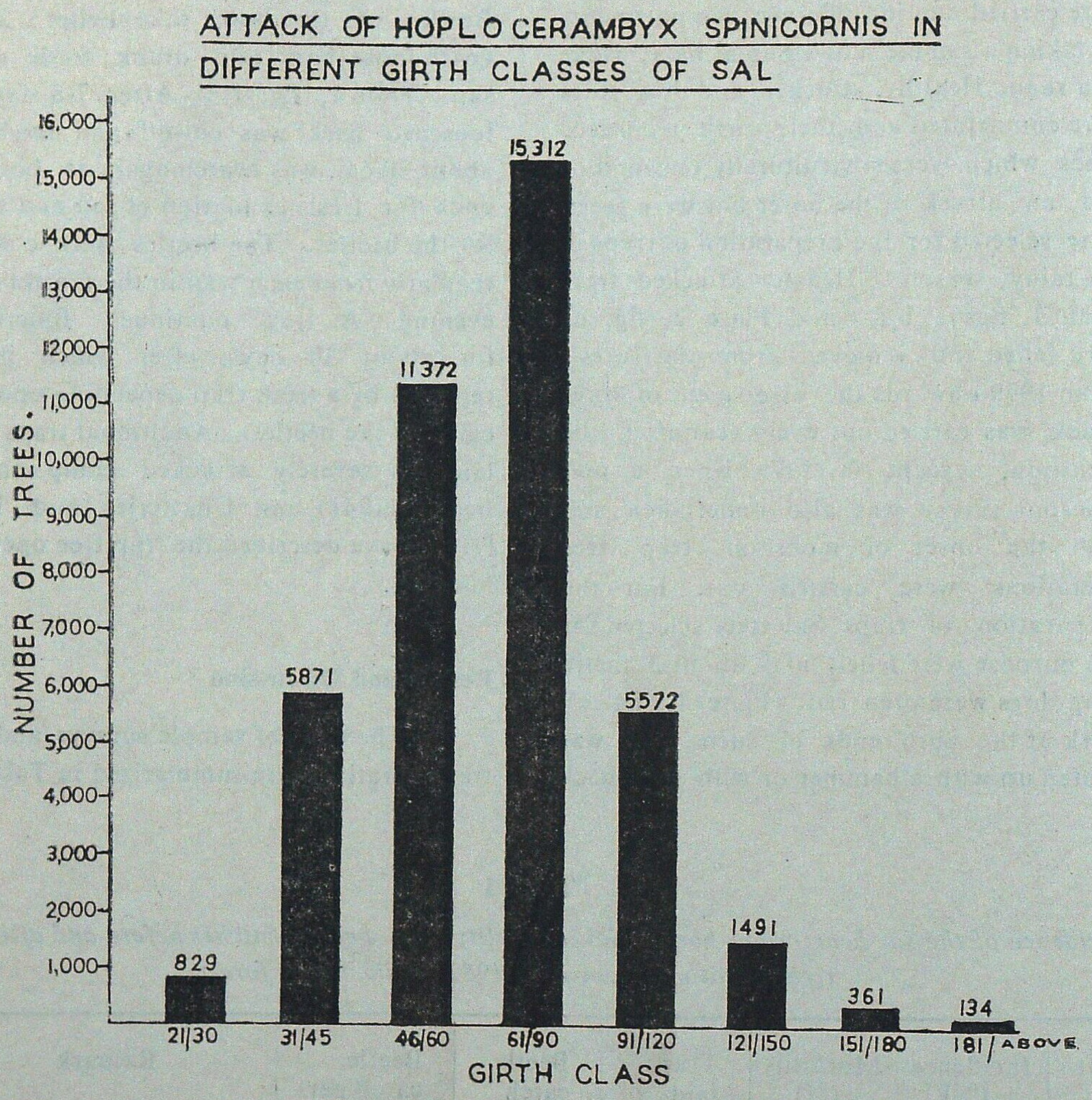
The data of sample surveys and trap tree operations are summarized in Table 1.

Table 1

Incidence of the sal heart-wood borer, Sal mortality and beetle catches before and after trap tree operations from 1979-1982 in Pachmari forest.

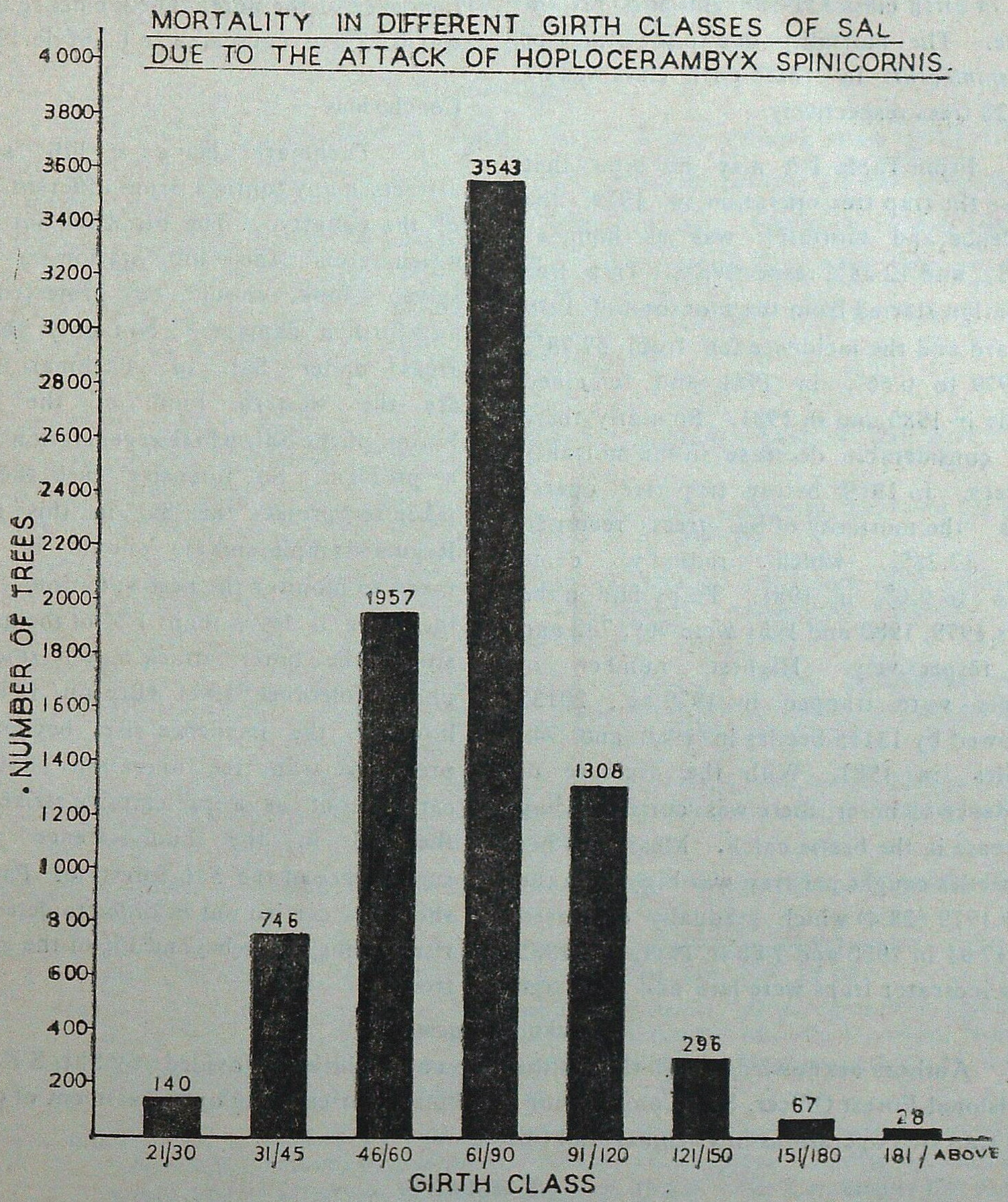
Year	Incidence (%)	Mortality (%)	Traps laid	Beetle catch	Beetle catch per trap	Remark
1979	57.23	12.28	—	—	—	Before trap tree operation
1979	7.4	3.8	709	20135	28.4	After trap tree operation.
1980	7.4	3.6	702	13115	17.91	-do-
1981	0.66	0.0	95	749	7.88	-do-
1982	0.75	0.0	Nil	—	—	No trap tree operation was carried out.

Fig. 1



Living and dead Sal trees, with heart-wood borer attack were measured and classified according to different girth classes. The incidence of attack in different girth classes of Sal is shown in Fig. 1. The incidence was maximum in 61-90 cm girth class, under which 15312 trees had an attack of the heart-wood borer, followed by girth class 46-66 and where some 11372 trees were found attacked. The incidence was less in lower and higher girth class. The minimum incidence was in the girth class. 181 cm and above where only 134 trees were found attacked. Mortality in different girth classes is shown in Fig. 2. Maximum mortality was observed in 61-90 cm girth class in which 3543 trees were killed followed by 1957 trees in 46-60 cm girth class, 1300 in 91-120 girth class, 746 in 31-45 and 226 in 121-150, 140 trees in

Fig 2



21-30 cm girth classes in the lower range and only 67 in 151-180 and trees in 181 and above girth class in higher range. The highest incidence of borer attack as well as the maximum mortality were observed in the girth class 61-90 and this gradually decreased on the lower as well as higher girth classes. Higher girth class (181 and above) had lowest mortality as well as incidence of the borer attack. The Sal

forest of Pachmari is composed of young and middle aged trees and there are few trees of girth class 151-180 cm and 181 cm above. The mortality due to the attack of *H. spinicornis* in these girth class was 67 and 28 trees respectively.

From Table 1 it may be seen that before the trap tree operation in 1979, the incidence and mortality was as high as 57.23% and 12.28% respectively. Trap tree operation started from the monsoon of 1979 onward and the incidence fell from 57.23% in 1979 to 0.66% in 1981 and remained steady in 1980 and in 1981. Similarly there was considerable decrease in the mortality of trees. In 1979, before trap tree operations the mortality of Sal trees recorded was 12.28%, which radually came down to 0.0% in 1981. Traps laid in the years 1979, 1980 and 1981 were 709, 732 and 95 respectively. Highest number of beetles were trapped in 1979 i.e., 20135 followed by 13115 beetles in 1980 and 749 beetles in 1981. With the decrease of incidence of borer, there was corresponding decrease in the beetle catch. Mean number of beetles caught per trap was highest in the year 1979 (28.4) which gradually decreased to 17 91 in 1980 and 7.88 in 1981. In 1982 only indicator traps were laid and no large scale trap tree operation was carried out, which resulted in a slight increase in the incidence of the borer. The incidence in 1982 was 0.75% as compared to 0.66% in 1981.

Conclusions

Pachmari, being a hill station, attracts many tourists from different parts of the country. The beautiful Sal forest, which gives this hill station a green sylvan look, should be protected from any further damage. Not only this, the areas under Sal in Pachmari Range are the western limit of the distribution of the Sal, where regeneration is also a problem. So intensive care should be taken to protect the Sal in this region. Regular sample surveys should be undertaken to monitor the pest situation. If the incidence is less than 1 % of the growing stock, the borer attack may be said to be under tolerance level (Beeson, 1941). If however, the incidence rises beyond 1%, preventive trap tree operation should be carried out as a pre-emptive strike to nip the evil in the bud. Hence regular surveillance of the Sal forest of Pachmari should be carried out in order to detect any rise in incidence beyond 1% of the growing stock.

Acknowledgements

Authors acknowledge with thanks the help and facilities provided by Shri S K. Vyas, Divisional Forest Officer, Soil Conservation, Pachmari, for carrying out assessment of damage and trap tree operations in Pachmari Sal forest.

SUMMARY

Epidemic of Sal heart-wood borer, *Hoplocerambyx spinicornis* was reportrd in 1979 from the hill resort of Pachmari, Madhya Pradesh. The very existance of Sal around Pachmari was threatened. Sal forest has great aesthetic value for this hill resort. So extensive trapping operations were carried out from 1979 to 1981 to control the borer, which brought down the incidence of attack from 57.23 per cent in 1979 to 0 75 per cent in 1981 and mortality from 12.28 per cent to 0.0 per cent which are below the tolerance levels.

साल सारकाष्ठ छिद्रक, होप्लोसेराम्बिक्स स्पाइनिकार्निस न्यूम (कचुकपक्षगण : दीर्घशृंगकवश) का व्यापक रूप से लगना तथा पचमढ़ी, म०प्र० में उसका नियन्त्रण

आर०एस० भण्डारी व प्रताप सिंह

साराँश

1979 में पर्वतीय विश्राम नगरी, पचमढ़ी, म०प्र० से साल सारकाष्ठ छिद्रक होप्लोसेराम्बिक्स स्पाइनिकार्निस व्यापक रूप से लगने की सूचना मिली थी। इससे पचमढ़ी के आस-पास लगे साल का अस्तित्व ही खतरे म पड़ गया था। इस पर्वत नगरी में साल का बहुत सौन्दर्य मूल्य है। इसी कारण 1979 से 1981 तक इन कीड़ों का जाल में फंसा कर पकड़ने और इस तरह नियन्त्रित करने का कार्य विस्तार से किया गया जिसके फलस्वरूप कीटाक्रमण का आपात 1979 के 57.23% से घटकर 1981 में 0.75% पर तथा वृक्ष मरण का प्रतिशत 12.28% से घटकर 8 0% पर आ गया जो सह्यना स्तर से भी नीचे है।

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CHEMICAL STUDIES ON OIL-SEEDS OF FOREST ORIGIN

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Introduction

Oils and fats are the essential and indispensable ingredients of human and animal diet. In addition to this they are also required in numerous industries such as paints and varnishes, soaps, cosmetics, textiles, pharmaceuticals etc. Until late forties we were producing enough to meet our requirements (Gulati *et al*, 1982). Due to the population growth and expansion of industries, our requirements went on increasing and we began to import vegetable oils after 1964. Since the year 1976-77 substantial quantities of oils and fats have been imported every year. During the year 1983-84 the import was as high as 16.34 lakh tonnes (Rao, 1987).

Agricultural crops, which are our main source of oils and fats, alone cannot meet our demand. Since the last few years various agencies have drawn the attention of scientists and technologists towards the utilization of the oil-seeds of forest origin. At present seeds of *Shorea robusta* (Sal), *Madhuca longifolia* var. *latifolia* (Mahua), *Azadirachta indica* (Neem) along with small quantities of *Derris indica* Syn. *Pongamia pinnata* (Karanj), *Schleichera oleosa* (Kusum) *Salvadora oleoides* (Khakan) *Calophyllum inophyllum* (Undi), *Mesua ferrea* (Nahor), *Garcinia indica* (Kokum) etc. are being utilized for the extraction of fatty oils on commercial scale. It is estimated that if we utilize the available potential of seeds of forestry origin we may easily get 11.23 lakh tonnes of fatty oils. (Gulati *et al*, 1982) but the actual production is hardly one lakh tonne. A research project was, therefore, taken up in Forest Research Institute and Colleges, Dehra Dun, to screen the seeds of selected forest species for their oil contents and studying the fatty oils isolated from the seeds for their physico-chemical properties and fatty acid composition. The present paper gives the oil contents of some of the seeds analysed so far.

Materials and Methods

The matured seeds of 31 forestry species were procured from different parts of the country. The kernels were separated out from the seeds and powdered. These were extracted thoroughly with petroleum ether (60-80°) in a soxhlet apparatus. In the case of those seeds from which the kernels could not be separated, powdered seeds as such were used for the extraction. In order to get the oil, the solvent from the extract was completely removed by distillation and traces of solvent from the residue were removed under vacuum. Seeds of *Abies pindrow* were found to contain essential oil besides the fatty oil. Hence in this case, the essential oil was first isolated by steam distillation and the seeds after drying, were extracted with petroleum ether, to get the fatty oil.

Results and Discussion

The place of collection of the seeds, percentage of kernels in the seeds and the yield of oil isolated from the seeds/kernels, are given in Table 1.

Table 1

Oil contents in seeds of forest origin

Name of the species	Place of collection	Seed/kernels used for extraction	% of kernels	Oil content (%)
1	2	3	4	5
Abies pindrow	Ranikhet (Nainital)	seed	—	28.76
Acer oblongum	New Forest (Dehra Dun)	-do-	—	2.69
Aesculus indica	-do-	-do-	—	2.00
Acrocarpus fraxinifolius	-do-	-do-	—	3.22
Adenanthera microsperma	-do-	kernels	50.6	15.64 (7.91)*
Adina cordifolia	-do-	seed	—	6.09
Albizia lebbeck	Haldwani (Nainital)	kernels	52 1	3.50 (1.82)*
Albizia procera	-do-	-do-	45.1	16.80 (7.64)*
Anogeissus latifolia	-do-	seed	—	0.88
Calamus tenuis	-do-	kernels	66.3	1.26 (0.84)
Cassia tora	New Forest (Dehra Dun)	seed	—	10.50
Costus speciosus	-do-	-do-	—	6.00
Cupressus torulosa	-do-	-do-	—	3.27
Dalbergia sissoo	Haldwani (Nainital)	kernels	27.2	9.57 (2.60)*
Dendrocalamus strictus	New Forest (Dehra Dun)	seed	—	1.60
Diospyros melanoxylon	-do-	-do-	—	2.98

(*Contd* ..)

1	2	3	4	5
Dysoxylum binectariferum	New Forest (Dehra Dun)	seed	—	4.54
Eucalyptus hybrid	Haldwani (Nainital)	-do-	—	3.68
Kydia calycina	New Forest (Dehra Dun)	-do-	—	4.92
Lannea coromandelica	-do-	kernels	17.4	36 04 (6.27)*
Michelia champaca	-do-	-do-	20.0	32.20 (6.44)*
Mitragyna parvifolia	Kanpur	seed	—	3.89
Olea dioica	Bombay	kernels	48.8	24.54 (11.98)*
Picea smithiana	Ranikhet (Nainital)	seed	—	21.56
Pinus roxburghii	-do-	kernels	60.5	41.32 (25.0)*
Prinsepia utilis	Chakrata (Dehra Dun)	-do-	62.5	43.52 (27.20)*
Schima wallichii	New Forest (Dehra Dun)	seed	—	18.77
Syzygium cumini	-do-	kernels	63.7	1.12 (0.71)*
Terminalia arjuna	Kanpur	-do-	1.28	10.80 (0.14)*
Toona ciliata	Mussoorie (Dehra Dun)	-do-	8.15	3.15 (0.26)*
Viburnum cylindricum	Chakrata (Dehra Dun)	seed	—	21.80

* Oil content (%) calculated on whole seed basis.

It can be seen that oil contents of seeds of *Abies pindrow*, *Picea smithiana*, *Pinus roxburghii*, *Prinsepia utilis*, *Schima wallichii* and *Viburnum cylindricum* range from 18.77% to 28.76% which may be considered as good for commercial exploitation provided sufficient quantities of seeds can be made available for extraction at a reasonable price. The kernels of the seeds of *Adenanthera microsperma* and *Albizia procera* constituting respectively 50.6% and 45.5% of the seeds have good oil contents (15.64% and 16.8% respectively), but special decorticators are required for separating the

kernels as the shells of the seeds are very hard. Seeds of *Michelia champaca* and *Lannea coromandelica* contain low percentages of kernels but containing good oil contents. It is therefore doubtful if these seeds can be commercially exploited. The seeds of other species cannot be considered as oil seeds.

Acknowledgements

The authors express their thanks to Shri B.S. Rawat, Silviculturist, Sal Region, Shri B.N. Dwivedi, Silviculturist, Hill Region, U.P., Nainital, and Shri V.K. Bahuguna, Assistant Silviculturist, Forest Research Institute and Colleges, Dehra Dun, for supplying the seeds. They are also grateful to Shri G P. Maithani, Director, Silviculture Research, Forest Research Institute and Colleges, Dehra Dun, for his keen interest in the work, and Officer-in-Charge, Systematic Botany Branch, Forest Research Institute and Colleges, Dehra Dun, for checking the botanical names in the paper.

SUMMARY

Results of analysis carried out on 31 forestry species have shown that oil contents of seeds of *Abies pindrow*, *Picea smithiana*, *Pirus roxburghii*, *Prinsepia utilis*, *Schima wallichii* and *Viburnum cylindricum* range from 18.77 to 28.76% and hence may be considered as good for their commercial exploitation provided sufficient quantities of these seeds can be made available at reasonable rates. Seeds of *Adenanthera microsperma* and *Albizia procera* are hard. Hence special type of decorticators are required for separating the kernels. Seeds of *Lannea coromandelica* and *Michelia champaca* contain low percentages of kernels the oil contents of which are good. The seeds of other species cannot be considered as oil seeds.

वनों से मिलने वाले तेल-बीजों का रासायनिक अध्ययन

पी०पी० जैन, एन०पी० डोभाल, राजेन्द्रपाल व के०एस० अय्यर

सारांश

31 वन वृक्ष जातियों के विश्लेषण के परिणामों ने दिखाया है कि एबीज पिण्ड्रो, पीसिया स्मिथियाना, पाइनस राक्सबर्घिआई, प्रिंसेपिया युटिलिस, स्किमा वालिशाई और वाइबर्नम सिलिण्ड्रीकम के बीजों का तेल तत्व 18.77% से लगाकर 28.76% तक है और इसलिए व्यापारिक समुपयोजन के लिये उन पर विचार किया जा सकता है बशर्ते कि उचित मूल्य पर बीज पर्याप्त मात्रा में उपलब्ध हो सकता हो। एडेनेन्थेरा माइक्रोस्पर्मा और एल्बीजिया प्रोसेरा के बीज कड़े होते हैं। अत: उनकी गिरी अलग करने के लिये विशेष प्रकार के छिलके उतार यन्त्रों की आवश्यकता होगी। लेनिया कोरोमण्डलिका और माइकेलिया चम्पका के बीजों में गिरियों का प्रतिशत कम होता है पर इनका तेल अच्छा होता है। अन्य वृक्ष जातियों के बीजों को तेल-बीज नहीं माना जा सकता है।

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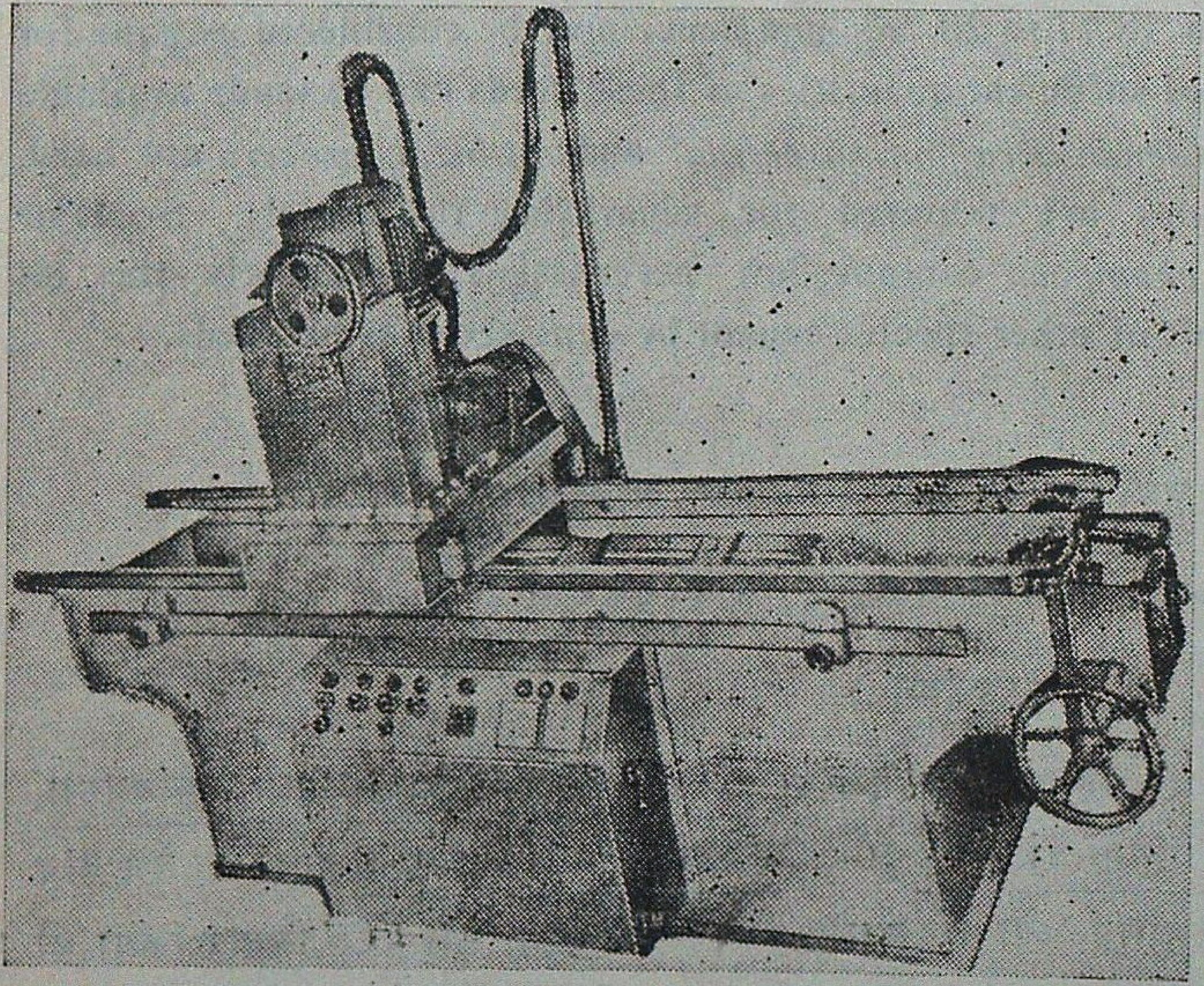

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VARARIA TRINIDADENSIS WELDEN – A NEW RECORD FROM INDIA

A.B. DE
Department of Botany,
Burdwan Raj College, Burdwan (West Bengal)

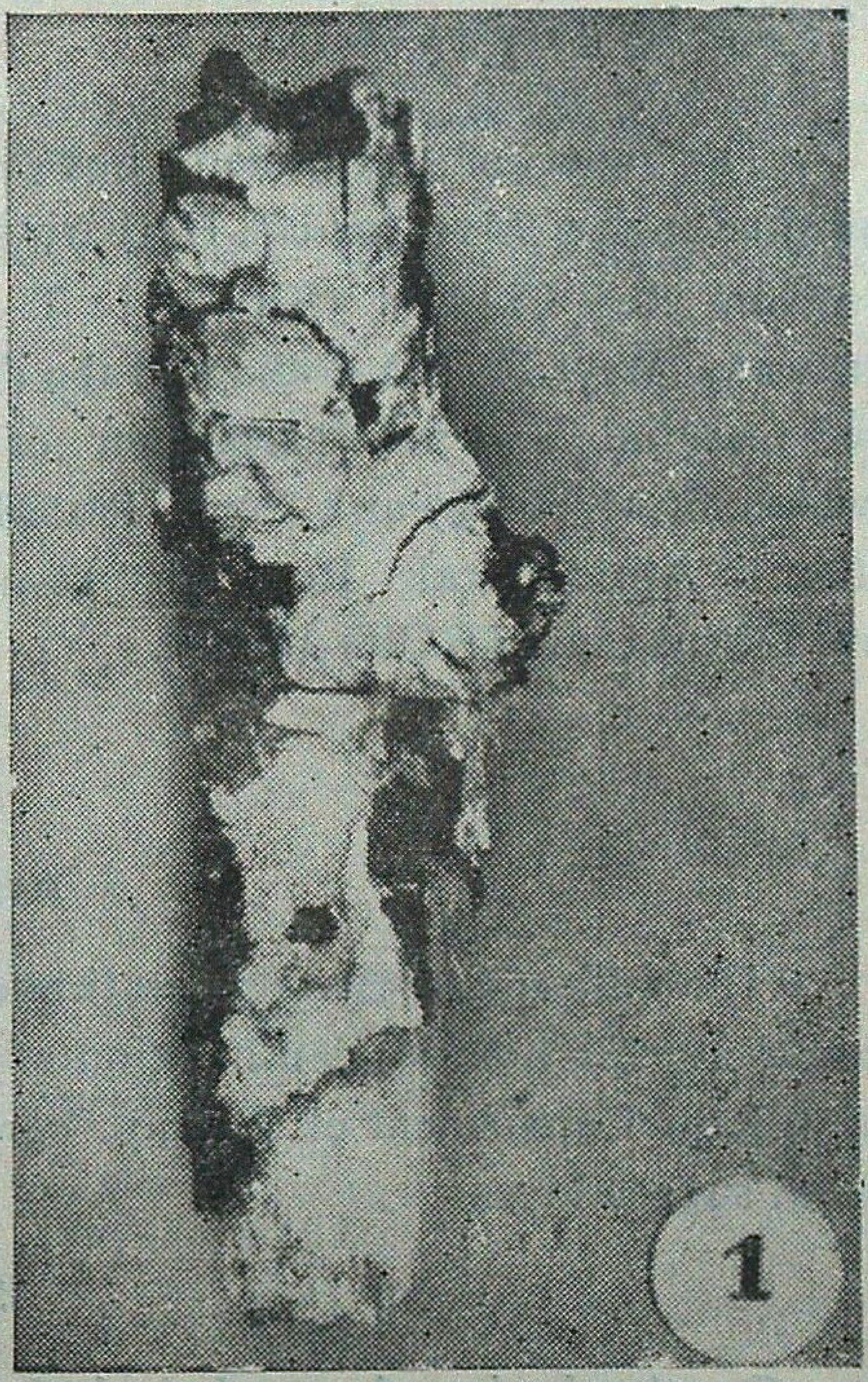
Introduction

During a mycological excursion in November, 1984, a non-poroid fungus of Aphyllophorales was collected by the author from a dead fallen branch of an unknown angiosperm at Chandak, Uttar Pradesh, India. It was identified as *Vararia trinidadensis* Welden. Perusal of literature (Bilgrami *et al.*, 1979, 1981; Butler and Bisby, 1960; Mukerji and Juneja, 1975; Rattan, 1977; Tandon and Chandra, 1976; Tilak and Rao, 1968) revealed that this report constitutes its first record from India. Morphological and anatomical characters of the species based on this collection are given below.

Morphology

Basidiocarp (Figure 1) resupinate, membranous to crustose, adnate, widely effused, up to 70 μ thick; hymenial surface pale bluish white to pale yellow, minutely powdery. Margin indeterminate, thinning, adnate, powdery, bluish white.

Fig. 1



Basidiocarp of *Vararia trinidadensis* Welden. growing on a dead branch of an angiospermic plant.

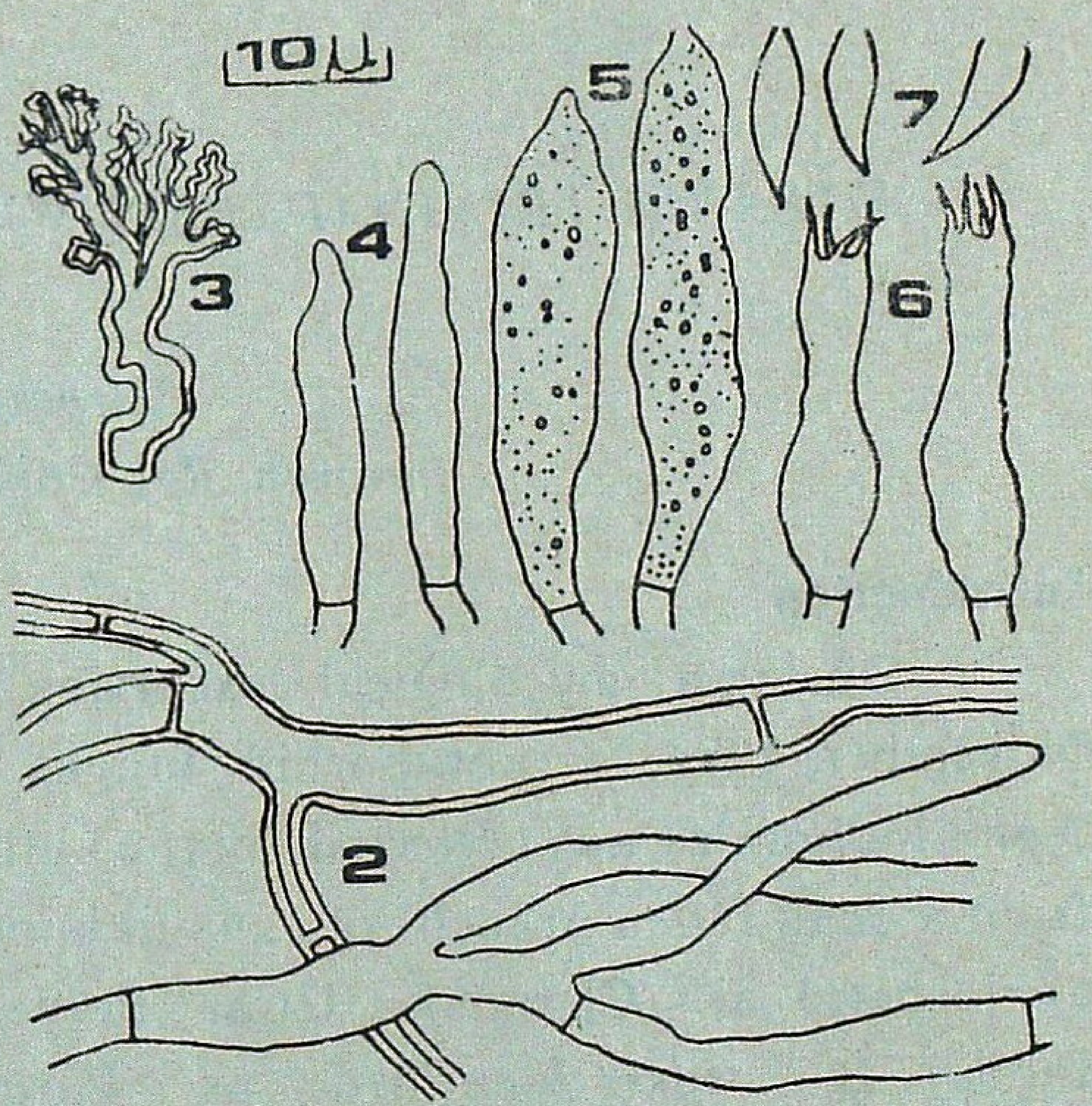
Anatomy

Generative hyphae hyaline, thin to slightly thick-walled, moderately branched simple septate, occasionally inflated, 2.2–5.5 μ in diameter (Fig. 2); dichophyses abundant, branched with very short internodes, becoming dendrophysoid, some with internodes almost completely absent and resembling acanthophyses, ultimate branchlets blunt and obtuse, the walls moderately thick, subhyaline, dextrinoid, cyanophilous (Fig. 3); cystidioles hyphoid, cylindrical to cylindrical-clavate, usually projecting beyond the dichophyses, 20.7–25.4 × 3.5–4.5μ (Fig. 4); gloeocystidia clavate, cylindrical or ventricose, empty or with subhyaline refractive contents, immersed or projecting slightly out of the hymenium,

thin to slightly thick-walled, 30.5–35.0 × 5.5–7.0 μ (Fig. 5); basidia utriform, 5.0–6.0 μ in diameter at base, 3.0 μ in diameter at neck and 4.0 μ in diameter at apex, up to 26.5 μ long, hyaline, thin-walled, tetrasterigmatic, sterigmata tapering, each 4.0 μ long (Fig. 6); basidiospores hyaline, thin-walled, smooth, nonamyloid, sharply attenuated below the middle and sometimes sharply bent, obliquely apiculate, 10.5–12.5 × 2.5–3.0 μ (Fig. 7).

The voucher specimen has been deposited in the Mycological Harbarium of Burdwan Raj Collage (BRCMH T 31), Burdwan, West Bengal, India and the duplicate material in the herbarium of the Division of Mycology and Plant Pathology, Indian Agricultural Research Institute, New Delhi, India (HCIO 37186).

Fig. 2-7.



Microstructures of *Vararia trinidadensis* Welden.
2. Generative hyphae. 3. Dichophysis. 4. Cystidioles. 5. Gloeocystidia. 6. Basidia. 7. Basidiospores.

Acknowledgements

The author expresses his gratitude to Dr. J. Boidin, 17 Rue Duguesclin, 69006 Lyon, France, for his help in identification of this fungus The author is also grateful to Dr. Anjali Roy, Department of Botany, Visva-Bharati, Santiniketan, West Bengal, India for her helpful suggestions.

SUMMARY

On the basis of morphological and anatomical characters the *Vararia trinidadensis* Welden is described as new record from India.

वैरेरिया ट्रिनीडाडेंसिस वेल्डन—भारत से नवोल्लेख

ए० बी० डे

सारांश

रचनाकारिकीय और शारीरीय लक्षणों के आधार पर वैरेरिया ट्रिनीडाडेंसिस वेल्डन को भारत से नवोल्लेख के रूप में वर्णित किया गया है।

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RESEARCH NOTES

(I)

STANDARDIZATION OF *IN-VIVO* NITRATE REDUCTASE ACTIVITY IN *ALBIZIA LEBBECK, ACACIA NILOTICA* AND *DALBERGIA SISSOO*

Application of inorganic nitrogenous fertilizer and its uptake, translocation and assimilation have been subject to extensive study in the agricultural crops in relation to growth and development. Due to the abrupt increase in the prices of chemical fertilizers, its application to the production forestry have become uneconomic especially for the underdeveloped and developing countries. Therefore, there is a great need in the present past to understand, how different fast growing tree species potentially utilize the soil nitrogen for biomass production under different climatic conditions.

The primary nitrogen assimilatory enzyme responsible for the reduction of soil nitrate to nitrite during its assimilation is known as nitrate reductase (EC. 1.6. 6 1.). In the present report, phosphate buffers with different pH and molar concentrations and substrate (KNO_3) concentrations were tested to find out their suitable combinations to obtain the optimum rate of nitrate reductase enzyme activity in the leaves of three fast growing tree species i.e., *Albizia lebbeck*, *Acacia nilotica* and *Dalbergia sissoo*. So that their nitrogen utilization pattern can be assessed by estimating the enzyme assay regularly at certain interval. The details regarding the materials and methods were already reported elsewhere by Pokhriyal and Raturi (1984, 1985 and 1986). This information will be useful for the research workers interested in the future research work on nitrogn metabolism (uptake, translocation, assimilation and fixation) in *Albizia*, *Acacia* and *Dalbergia* species under different climatic conditions. Results are presented in Table 1.

Table 1

Buffer solution and substrate concentrations, which have shown maximum In-vivo Nitrate reductase activity in Albizia lebbeck, Acacia nilotica and Dalgergia sissoo leaves.

Name of the species	Buffer solution		Substrate (KNO_3) Conc. (m)
	pH	Conc. (m)	
Albizia lebbeck	7.5	0.1	0.25
Acacia nilotica	7.5	0.2	0.20
Dalbergia sissoo	7.5	0.1	0.10

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A.S. Raturi,
H.O. Nautiyal
& S.R. Joshi

(II)

TEAK PLUS TREES FOR SPECIFIC TRAITS

Pearson and Brown (1932) have beautifully illustrated the wood types in Teak with the mention of occurrence of straight or wavy-grained wood. They further emphasized that usually the wet zone teak possess straight and even grains while less straight grain may rarely occur in dry zone teak. Further Limaye (1954) classified teak on the basis of wood fibre alignment into straight grained timber. This shows that under stress conditions only slight variation from straight grain is expressed by the individuals. This may be due to the a symmetrical functioning of Cambium in adverse conditions and hence the environmental effect only, which is of no use to tree breeders.

Wavy-grained character is genetically governed in Birch (Newall and Gardiner, 1963). Wavy-grained logs of Red Sanders have been of great economic interest in Indian export market and attracted Forest Scientists to study the variations at fibre level (Kedharnath and Rawat, 1976).

Kedharnath (1980) illustrates the important progress made in the country in breeding work in respect of teak etc., with the mention of overall 600 plus trees in various states. Together with Coimbatore one gene bank was to be established in Dehra Dun also as per the guidelines by Mathews (1961) which is still to be organized by planners in Forestry Research.

Till now the emphasis in teak plus tree selection has been given to vigour, form and crown of the selected tree in comparison to its check trees. This yields in the quantity wood production of future plantations. A new approach has been undertaken by the authors having coming across the trees of *T. grandis* for different purposes than yield or quantity of wood.

The present communication is to record a freak in teak for wavy grain from wet zone with a suggestion to Forestry personnels involved to study the extent and multiply the clone in their gene banks for future use.

This tree of teak for wavy grain was selected as the check tree of plus tree No. 2 from 1917 plantation, Mavinhulla, Muthanga Range, Wynad Sanctuary Division, Kerala. The occurrence of such teak tree from wet zone suggests that advers and stress conditions only are not indispensable for the expression of wavy-grained characters. On the other hand strong hold of the genotype may be the probable reason.

Teak is reported to be frost susceptible to a high degree and thus its introduction to frost belt of Northern India has been a problem since long. During the course of Tree Improvement Programme a clone has been identified which is not only highly frost resistant but also gives very

good germination. This clone may help to overcome the said problem. Together with this a clone for better growth has also been isolated. Having these two strains in the campus of Forest Research Institute yearly observations on various aspects have been recorded. The work has been taken over to the level of establishment of small seed orchards for these two strains with the objective of combining frost resistant and good growth traits in the geneticall: improved variety for large scale plantation in frost prone regions of the country.

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Indo-Danish Project on Seed Procurement
and Tree Improvement Centre,
F.R.I. & Colleges, Dehra Dun.

R.K Vakshasya,
D.P. Uniyal &
M.S Rawat

REVIEW

"Paper and Paperboards in India" (demand forecast and policy implications) by Tirath Gupta and Nitin Shah, pp. 96. Published by the Oxford & I.B.H. Publishing Co. Pvt. Ltd., 66 Janpath, New Delhi. Price Rs. 65.00

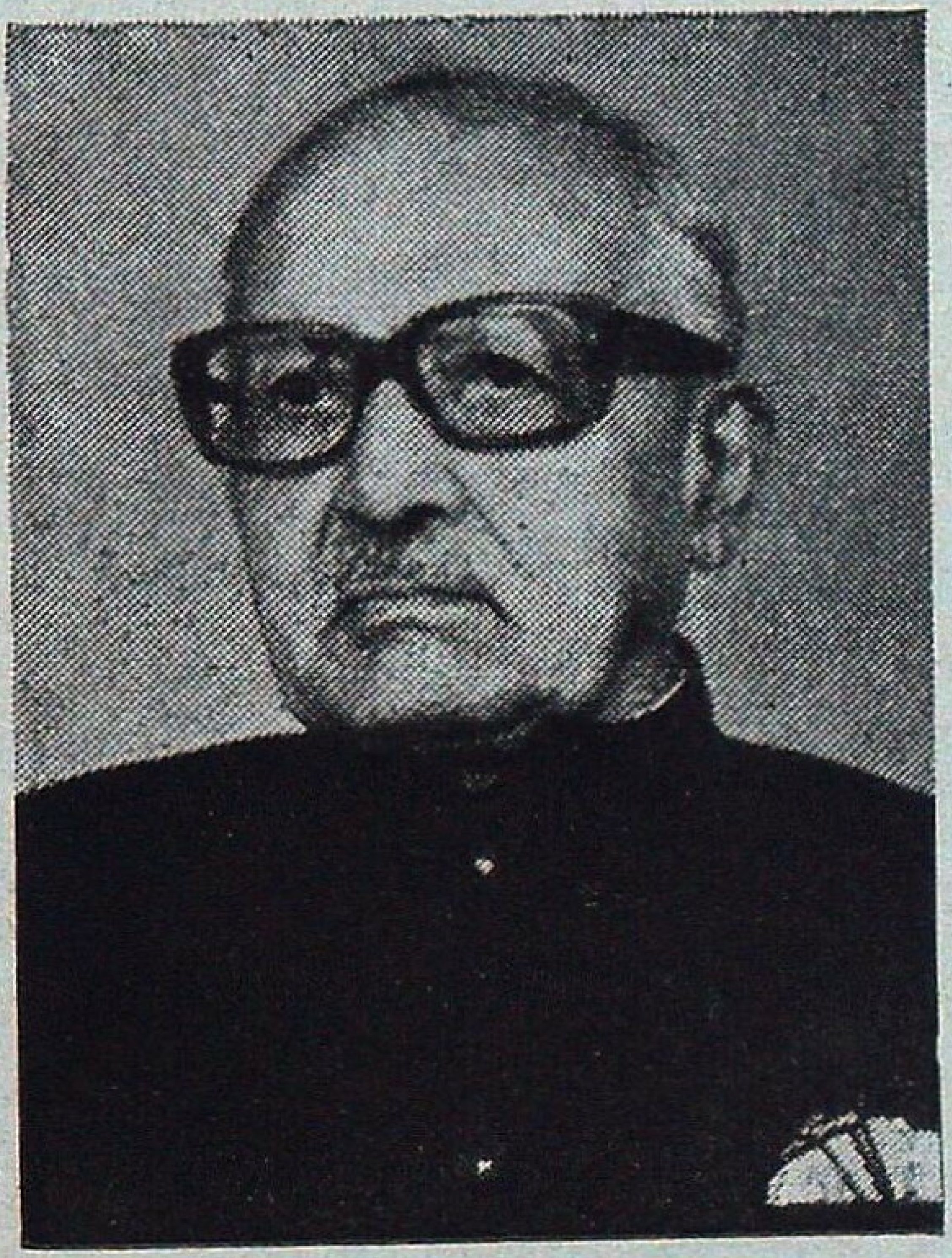
The authors have discussed in great details the anomalies that exist in the phenomenon of increase of the paper and paperboard units from 17 to 250 during 1950 to 1985 vis-a-vis the rise in the modest production figure from 137,000 tonnes to 2,350,000 tonnes during the same period with a declining trend of the capacity utilization from 90% during 1951-56 to 58% during 1980-85. They have tried to explain the anomalies with the help of several affecting parameters like per capita income, growth of literacy rate, stress on the education along with the rise in capital investment, the added costs due to pollution control measures and the rise in price for cellulosic materials. They have also taken a number of existing examples to elucidate the thoughts advanced, in addition a thorough review of the studies on this subject has been done side by side. The process of planning in the Govt. level though different from the general market economic behaviour of the product, they have discussed the same as well, since it has great bearing on the general market economy. In short this is a complete study on the subject and could be useful in right demand-forecast, policy planning etc. which could be effectively utilised by policy makers, industrialists, foresters and academicians.

R.N.B.

OBITUARY

Channira Muddaiah Kushalapa

(1894 - 1988)



The forest fraternity of India lost one of the oldest Forest Officer Shri Channira Muddaiah Kushalapa on the 28th January 1988. He was 94. He had retired as Chief Forest Officer of erstwhile Coorg State in 1951. He joined the provincial Forest service of Madras Presidency after his training in Imperial Forest College, at Dehra Dun in 1920. He had a brilliant academic career, with first rank in matriculation in Coorg State and later studied in Central College, Bangalore. He was not only a tall (181 cm), well built and gigantic figure but also a good marksman and shikari. He shot 24 tigers and panthers during his service and earned the name as an upright, straight forward and disciplined officer. He served in the composite Madras Presidency covering parts of the present Andhra Pradesh, Karnataka, Kerala and entire Tamil Nadu. He was an idealist and a model forest officer. He wore only Khadi dress while in service and even after retirement.

He was better known after his retirement when he settled in his ancestral house near Makut where the forest college trainees used to visit to study the Southern Tropical Wet Evergreen forests of Coorg. He invariably used to meet them in the forest and explain to them the complexity of evergreen forests, their species association and diversity, management etc.

His death is an irreparable loss to the forest service of India. He leaves behind two sons, six daughters and their children to mourn the loss, in addition to a host of serving forest officers of India and friends.

May his soul rest in eternal peace.

K.A.K.

GAZETTE NOTIFICATIONS

ANDHRA PRADESH GAZETTE

(1) Shri U Venugopal, I F S., Conservator of Forests, who stands posted as Conservator of Forests, Social Forestry, Karimnagar is posted as Conservator of Forests, Social Forestry, Office of the Principal Chief Conservator of Forests, A.P., Hyderabad.

(2) Shri C. Damodar Reddy, Conservator of Forests, who stands posted as Conservator of Forests, Social Forestry, Office of the Principal Chief Conservator of Forests, A.P., Hyderabad, is posted as Conservator of Forests, Project Formulation Circle, Hyderabad Vice Shri Satish Chandra, I.F S., Conservator of Forests transferred.

(3) Shri Satish Chandra, I.F S , Conservator of Forests is transferred and posted as Conservator of Forests, Social Forestry Circle, Karimnagar vice Shri U. Venugopal, Conservator of Forests, transferred.

(4) Shri D.V. Rao, I.F.S , Chief Conservator of Forests (Social Forestry) working in the Office of the Prl. Chief Conservator of Forests is transferred and posted as Managing Director, Andhra Pradesh Forest Development Corporation Ltd., Hyderabad, relieving Shri M. Sitarama Rao, I F.S., Chief General Manager, of additional charge.

(5) Under Article 72 of the Articles of Association of Andhra Pradesh Forest Development Corporation, the Government hereby appoint Shri D.V. Rao, I.F.S., as Director, Vice-Chairman & Managing Director, Andhra Pradesh Forest Development Corporation Ltd., from the date of taking charge.

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★ To preserve and protect the Similipahar Forest ;

★ To improve and enrich the growing stock, and to nurse back to health the degraded patches in the project area ;

★ To improve infrastructure like roads, godowns, rest house and staff quarters; and

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We have grown from a turnover of Rs. 43 lakhs during 1979-80 to Rs. 580 lakhs during 1981-82.

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TO SUIT YOUR REQUIREMENTS

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2. The Deputy Conservator of Forest
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Andamans Govt. Timber Depot,
3-A, 2nd Floor, Auckland Place,
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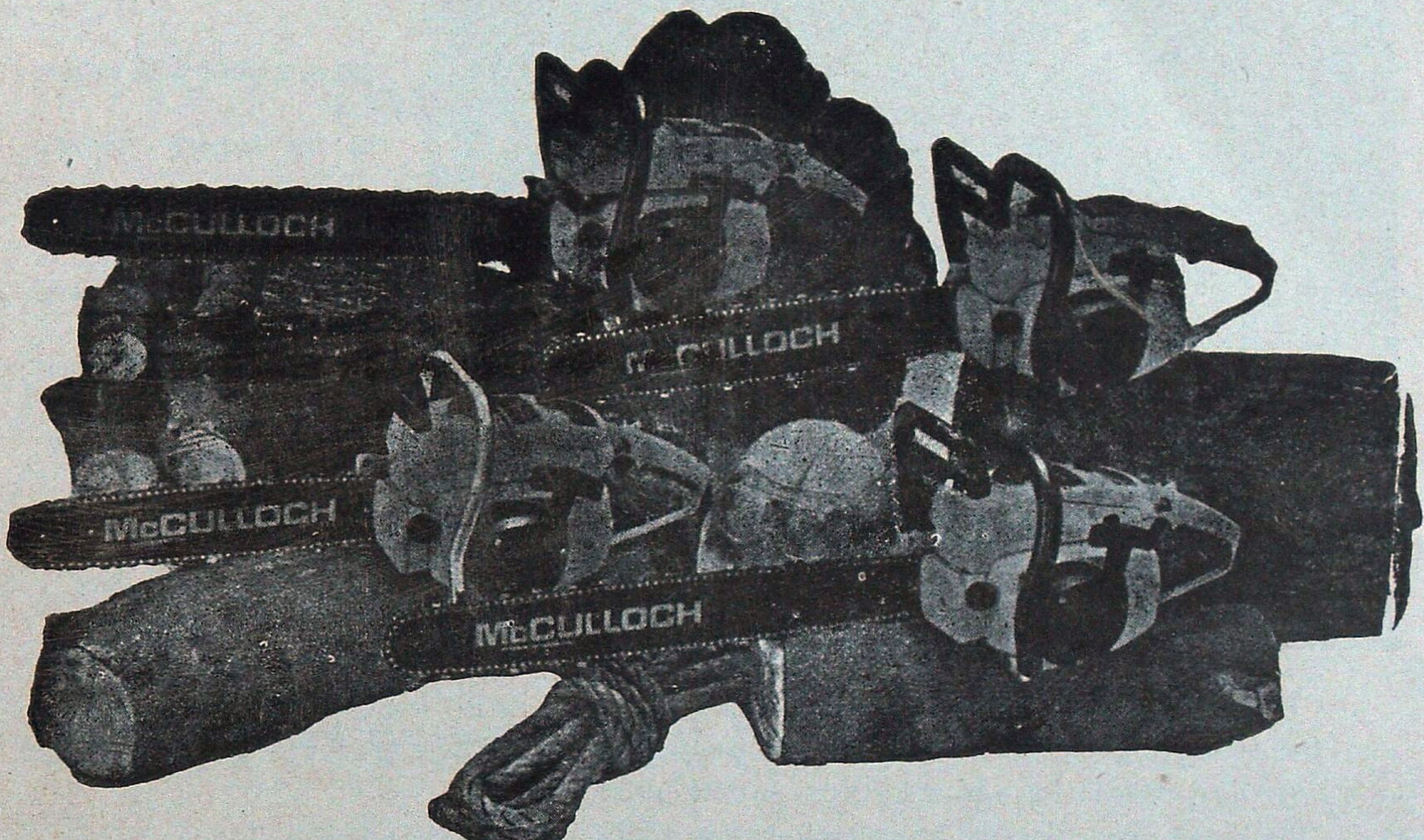

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Elephants, chital, sambar, hog deer, barking deer, wild boar, magar gharial etc. and incredibly large varities of numerous beautiful birds. There is also very good chance of s eing tiger, panther or a bear in their natural habitat.

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* Wildlife films screened daily free of charge.
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Eor other information contact or write to :

The Field Director, Project Tiger
Corbett National Park,
Ramnagar (Nainital), U.P. – 244715
Phone : 32, 189 Office
76 – Residence

OR

The Chief Wildlife Warden
17-Rana Pratap Marg,
Lucknow (U.P.)
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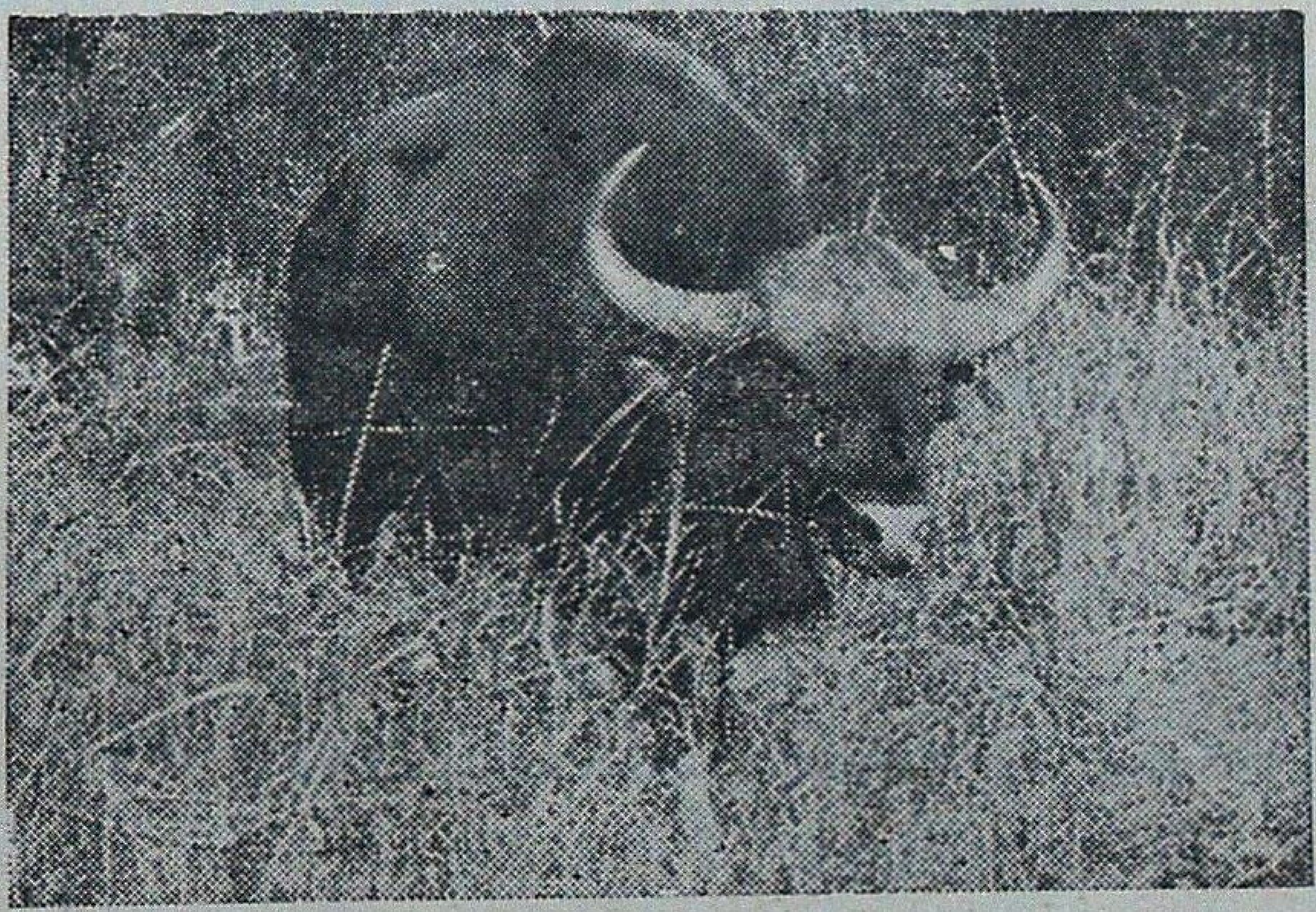

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(A Govt. of Arunachal Pradesh Undertaking)

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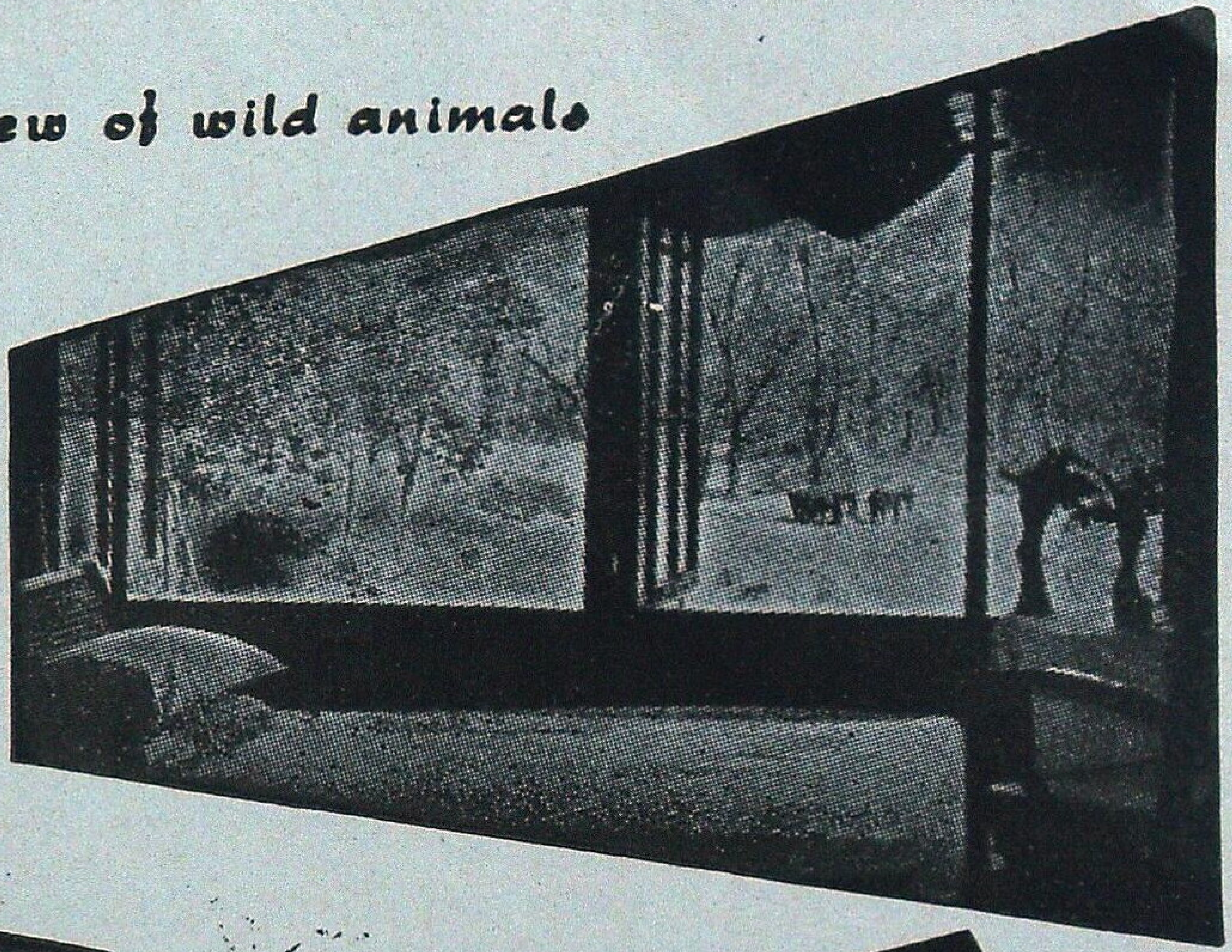
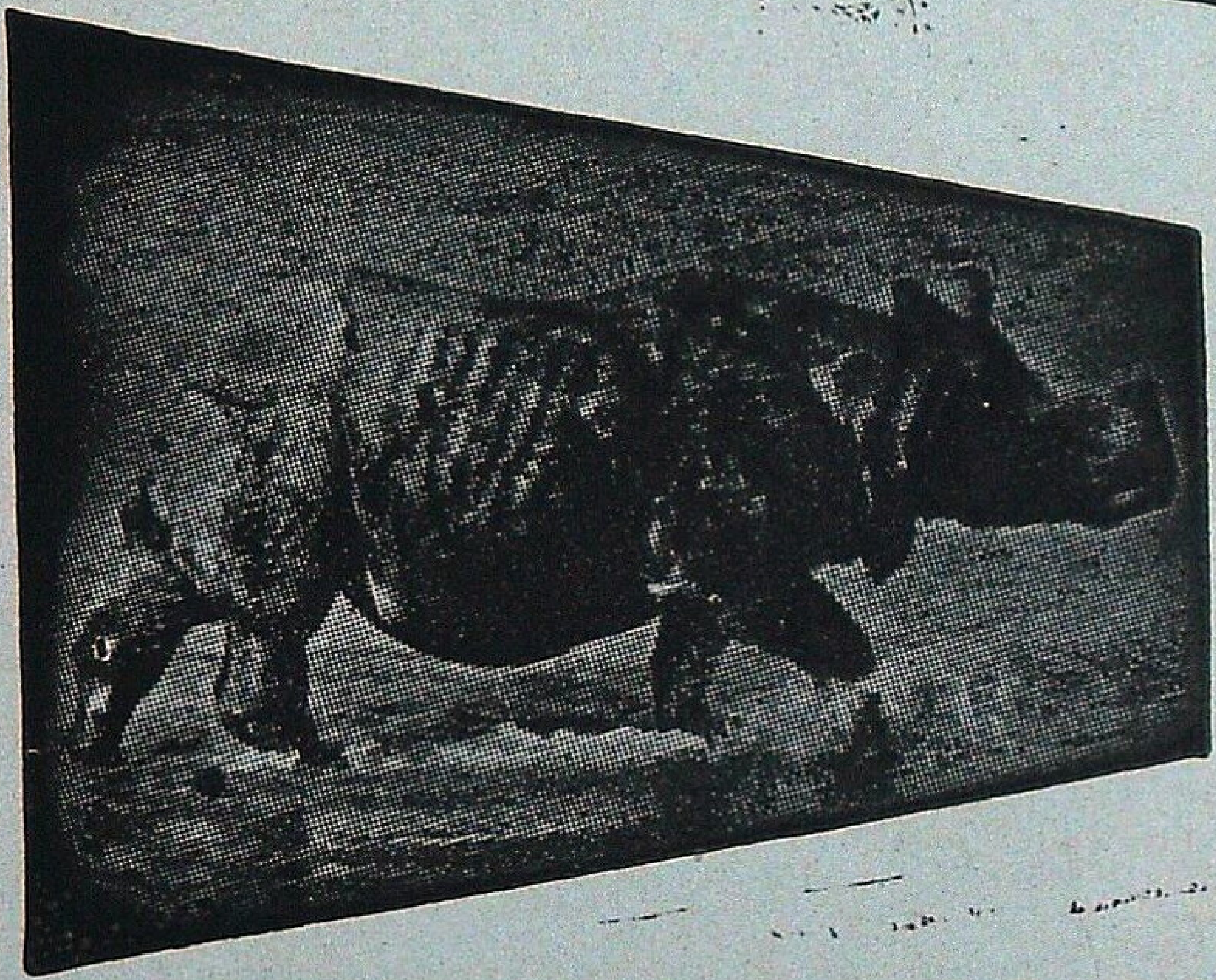


VISIT



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OR

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WEST BENGAL

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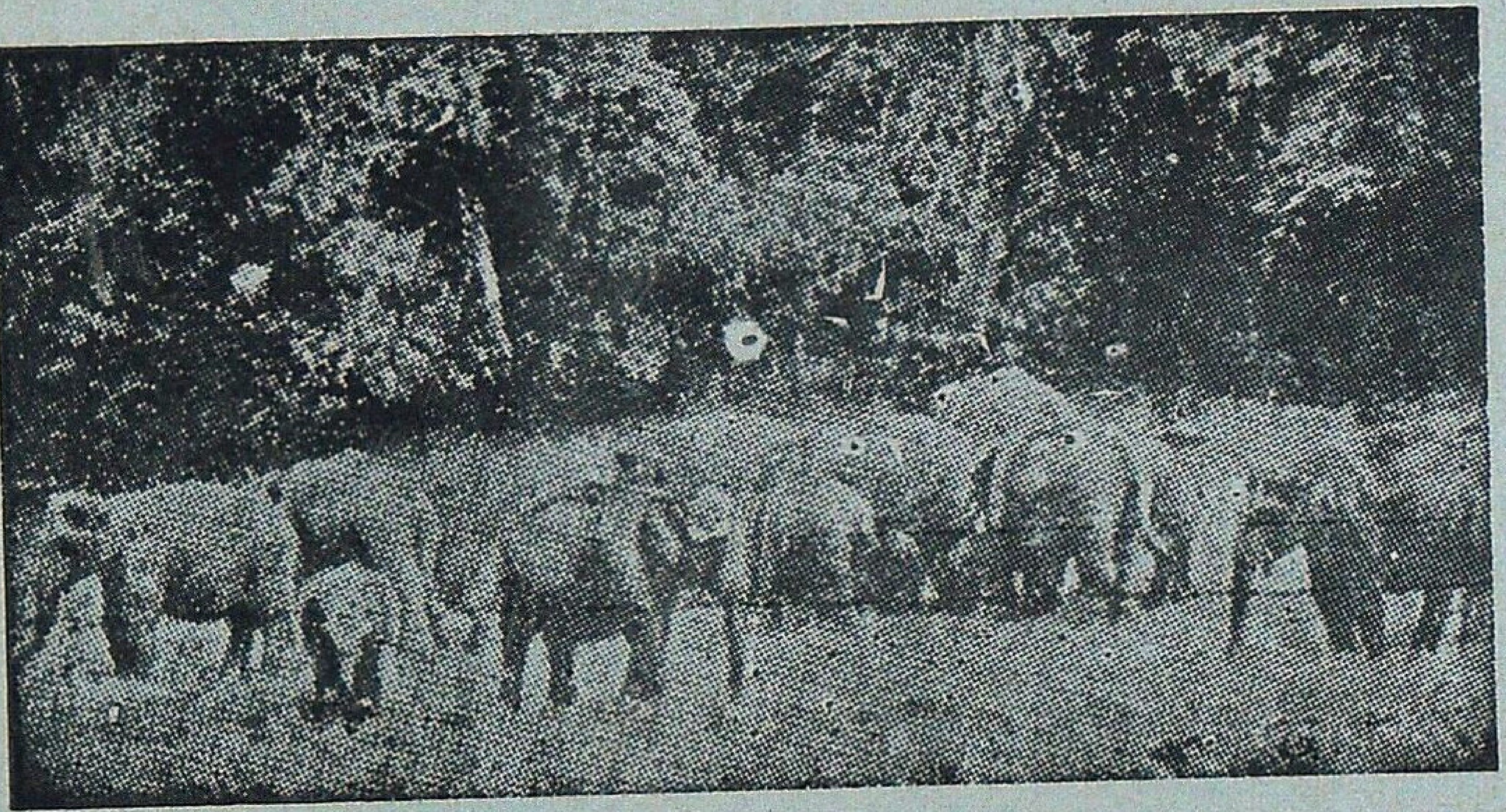
OBSERVE

Elephants, Gaur, Sambhar Leopard, Wild Dogs, Black Langur, The Giant Malabar Squirrel, B:rds and other indigenous Fauna.



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†Frunished Forest Rest Houses at Thannikudy, Mullakudy and Manakavala.
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Distance to Thekkady by roads is 190 km from Cochin, 145 km from Madurai and 110 km from Kottayam.

For further particulars contact :—WILD LIFE PRESERVATION OFFICER
Thekkady P.O., (Kerala) Telephone : KUMILY 27

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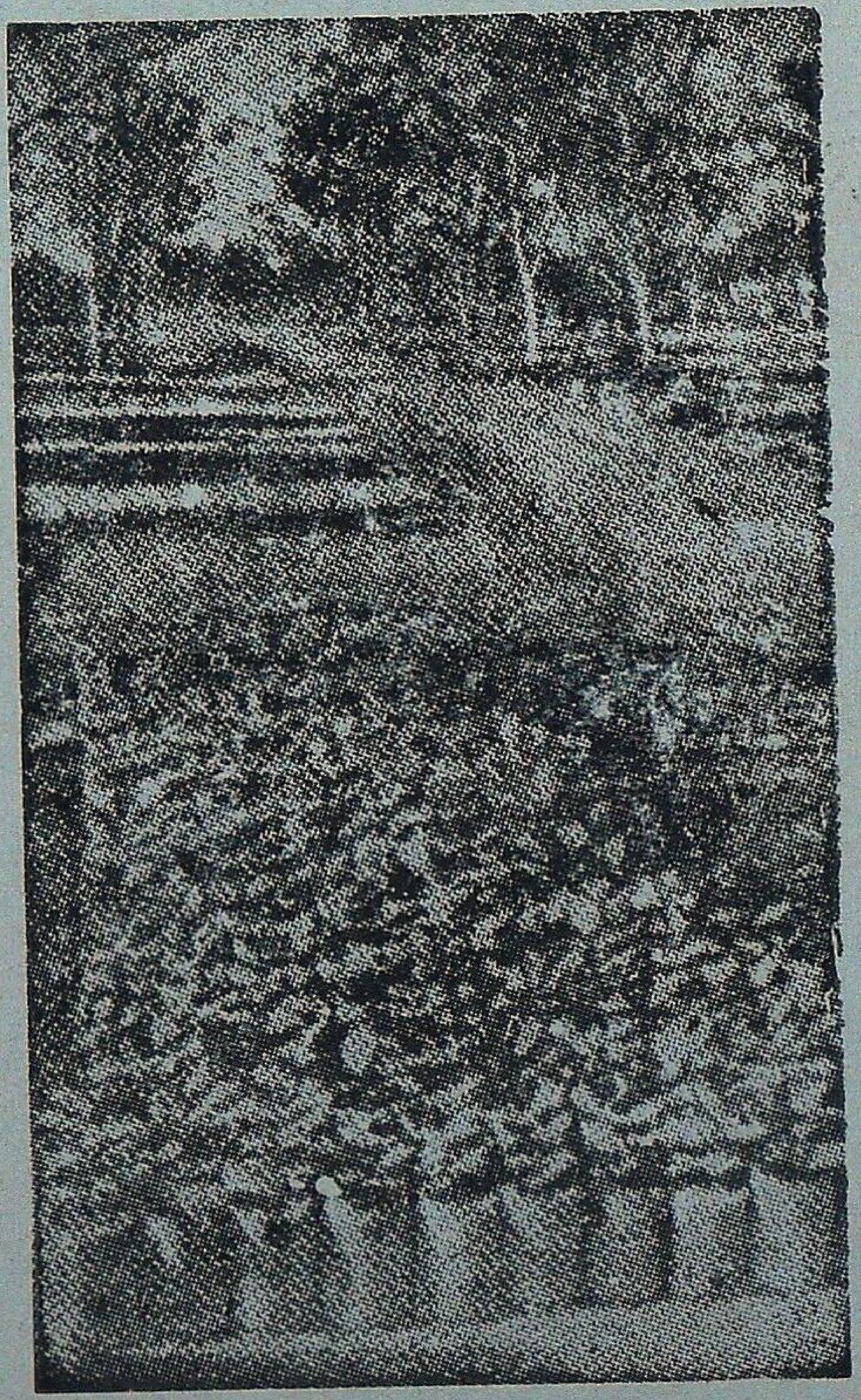


Himachal Pradesh State Forest Corporation Ltd.

(A Govt. of Himachal Pradesh Undertaking)

SHIMLA

HPFSC marches ahead towards a better tomorrow under the dynamic guidance and leadership of Hon'ble Chief Minister Shri Vir Bhadra Singh.

Himachal Pradesh State Forest Corporation has taken long strides under the benevolent guidance of our Chairman Prof. Chander Kumar, Hon'ble Minister of State for Forests.

* With complete nationalisation of forest working viz; timber operations, resin tapping etc. both in Govt. and private forests, there is complete elimination of contractor' agency. Modernisation of timber operations has reduced conversion wastage considerably and the incidence of organized illicit felling in forests is completely under control.

* To ensure gradual reduction in use of valuable coniferous timber for packing cases, effective steps have been taken for distribution of Card Board Cartons and purchase of Wooden Packing Cases from adjoining States of Punjab and Haryana.

* Stocks of timber extracted by Corporation are being supplied towards developmental works by catering to the requirements of Indian Railways, Director General of Supplies and Disposals, Defence Organisation and other Govt. Indenters. Sale of timber stocks is being organized through well established sale depots conveniently located.

* The annual turn-over has registered a significant increase from its inception from 1974-75 being Rs. 2.43 crores to Rs. 44.83 crores in 1986-87.

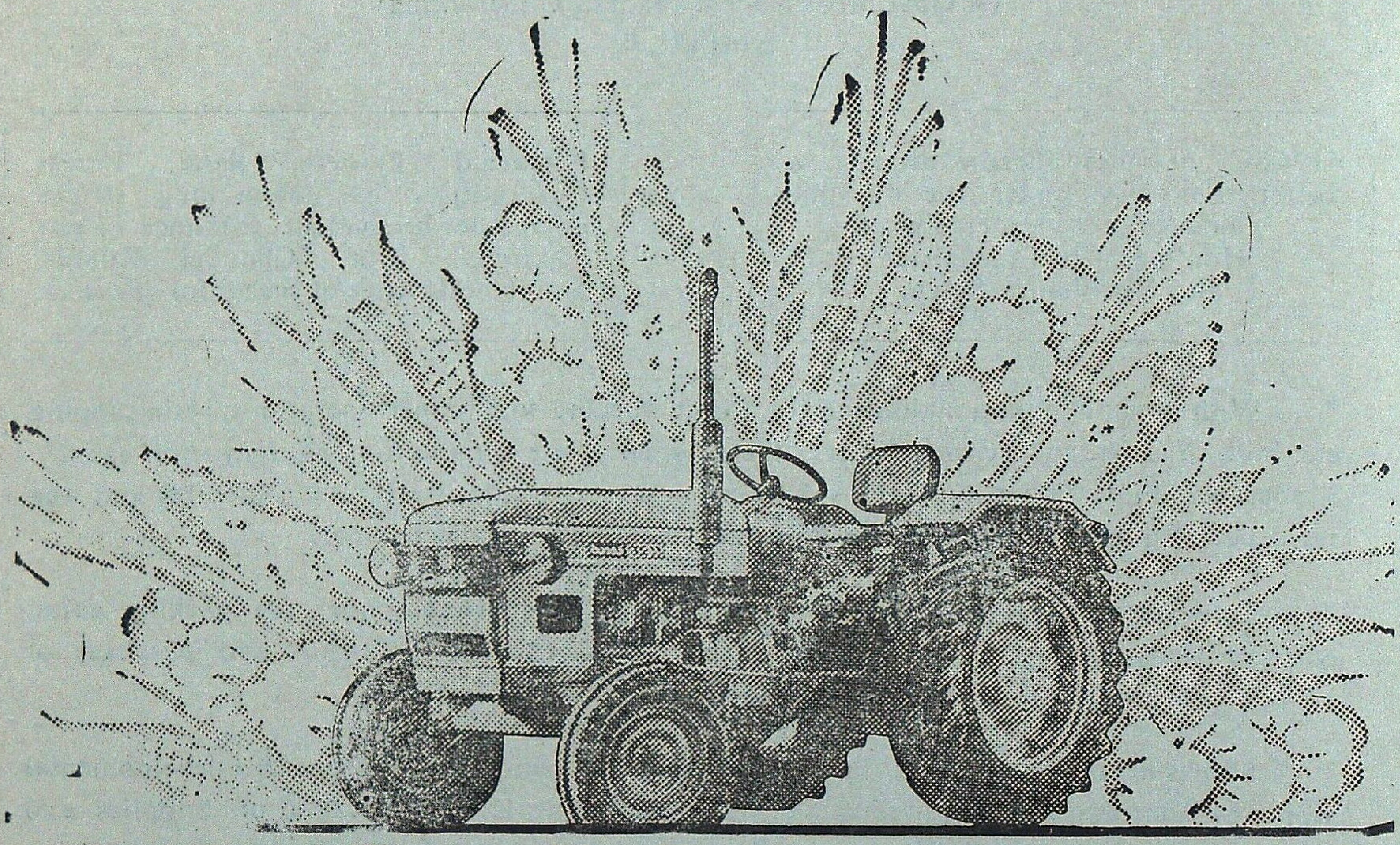
* In order to maximize operational efficiency, following steps have now been initiated :

a) Replacement of old fleet of trucks for minimising transportatton time of timber to depots;

b) Analysis of financial data through computer net-work to ensure prompt and efficient working.

c) Providing incentives to officers and staff through prompt action on service matters like confirmations, job rotation vis-to-vis career planning including specialized training.

(V.P. Mohan)
Managing Director.



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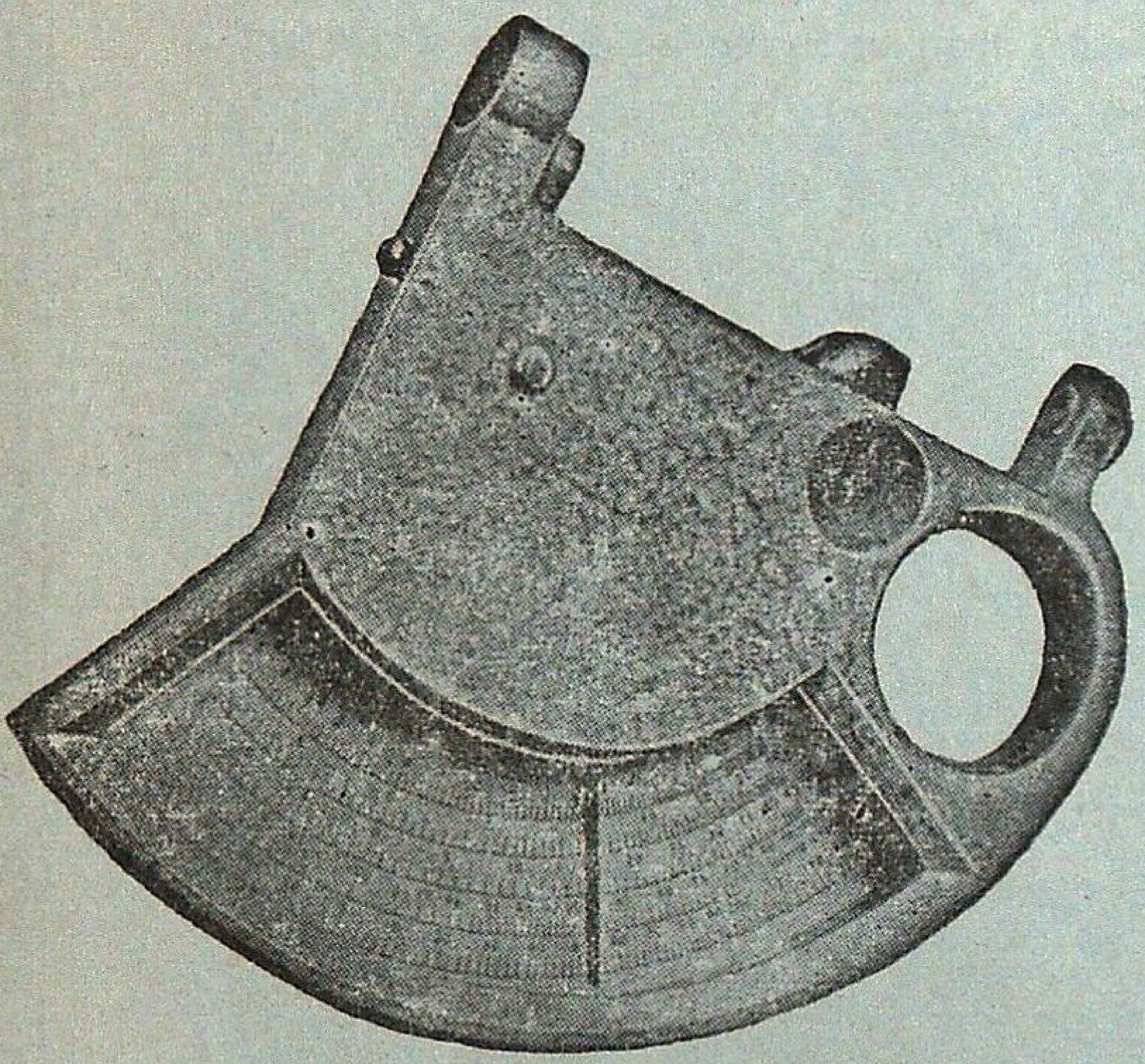

RAVI MULTIMETER

(Patent A Nos. 000191, 000192 & 000222)

A must for every Forest Officer

Ravi Multimeter gives heights of individual trees in plain or in sloping grounds, Basal Area for four factors 0.5, 1 0, 2 0 and 3.0 in metric units, Average Crop Height and Base Line. A very useful instrument for Working Plan, Pre-Investment Survey and Silvicultural Divisions.

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Available in 12 sections each of 2.5 m in length (one base section, ten mid sections and one end section) Any height upto 30 m can be conveniently reached by adjusting numbers of mid sections. Simple to assemble and light to carry. Useful in measurement of standing sample of trees and in plucking of seeds, Leather safety belt for use of climber available separately.

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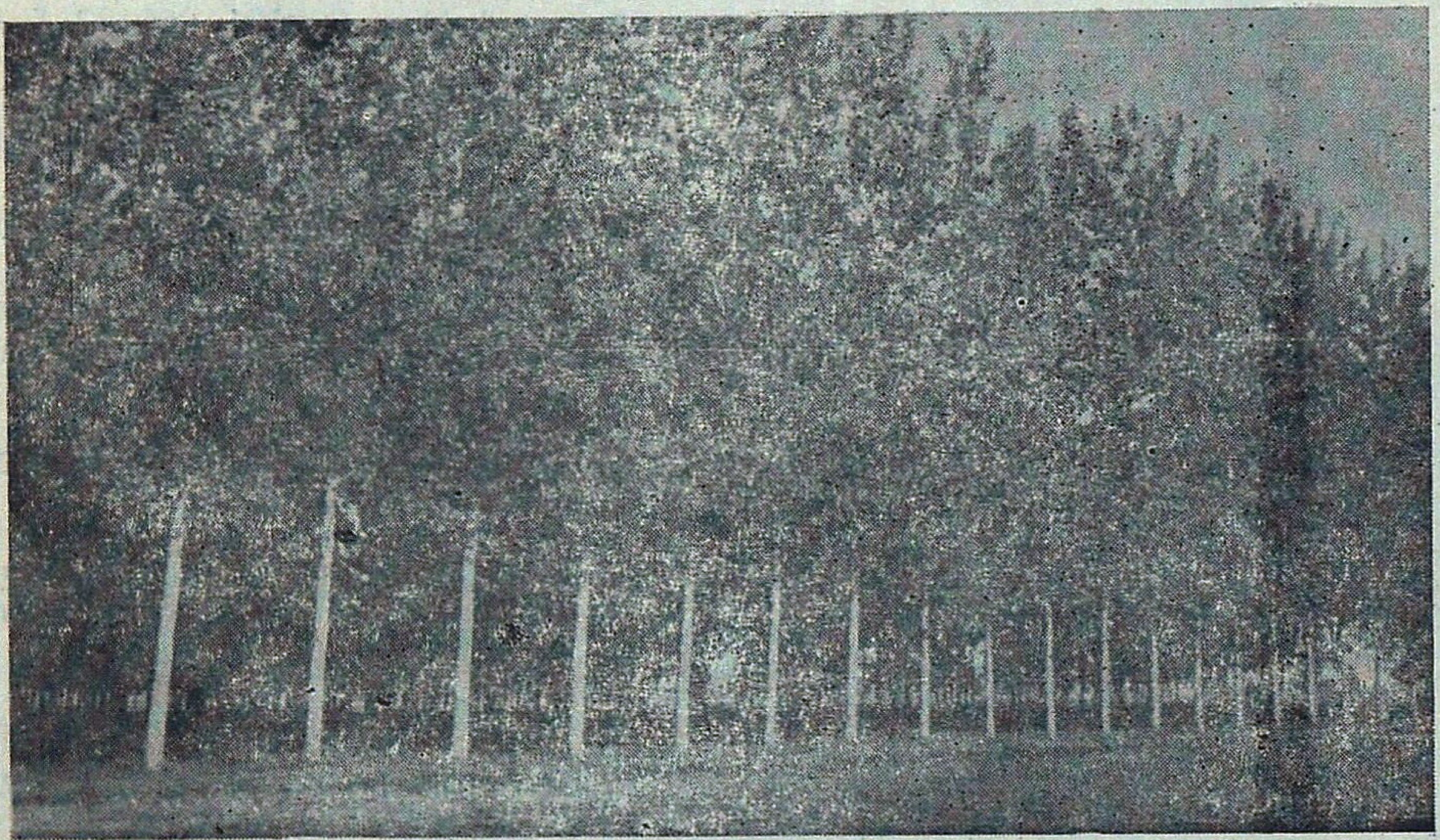

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Fully Furnished Forest Rest Houses
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BANDIPUR TIGER RESERVE

KARNATAKA

Lovers of nature and Wildlife the world over find it well worth their while to linger on in Bandipur. More famous as a Tiger Reserve, Bandipur enjoys reputation as a wildlife sanctuary that stretches as far back as 1931. The Mysore Maharajas; benign rulers and farsighted visionaries understood the compelling necessity of protecting the fauna, avifauna and flora from the thoughtless foreys of marauders. Today 874 sq kms. of the Bandipur National Park makes up the Tiger Reserve which is one of India's finest parks.

But Tigers, native to the country and the most magnificent of the great cats are saved from threatened extinction. An abundant variety of fauna: the panther, wilddog, Sloth bear, Sambar, Chital, barking deer, fourhorned antelope, common langur; avifauna like peacock, grey jungle fowl, crested hawk, eagle and reptiles such as crocodiles, Python, Vipers, etc., roam this park freely.

Hundreds of spotted deer greet the visitors right at Bandipur campus, at night times as they step out of comfortable cottages.

A herd of elephant majestically moving single file through a patch in the jungle can be viewed on an elephant ride. If one is lucky he can watch in absolute silence, of course—a herd of Indian 'bison' or gaur, locking horns a few meters away.

Nature at its bountiful best—Bandipur bestows the soothing solace of jungle retreat off the beaten track and far from the madding crowd.

For further particulars, please contact

The Field Director
'Project Tiger'
Government House Complex
MYSORE—570 010
(Karnataka—State)—India
Telephone No. 20901

Mizoram Forests Through The Years

During the British period i.e. from 1890 till the year 1952, the management of Inner Line Reserved Forests was done under the supervision of Superintendent of District. The District was put under 'Excluded Area' and practically no Statutory Act or Law were enforced to manage the Forests. Practically nothing had been done. The Inner Line Reserved Forests was constituted under the Assam Forest Regulation comprising an area of 559 sq kms.

When the Mizo District Council came into being in 1952, the management of all the Forest other than the State Inner Line Reserved Forests was handled by the District Council. Thence the District Council started to make its own Forest Wing. Under the District Council one Forest Division called Aizawl Forest Division was created comprising the then whole area with headquarters at Aizawl. In fact during the time of the then District Council, most accessible areas of the forests had been overtapped for earning more revenue and due to population pressures.

In the early 1960's the first plantations were raised by the District Council in different centres. During the year 1966 - 1968, practically no plantation could be raised due to political disturbance in the Mizo District.

After Mizoram became a Union Territory in the year 1972, the Union Territory Government formed one more Forest Division with headquarters at Lunglei.

The present position of Mizoram Forest Department may be summed up as follows :

The Mizoram Forest Department is headed by the Chief Conservator of Forests. The field work has been taken up with ten (10) Territorial Divisions. In addition to this, six (6) Functional Divisions have been set up. There are now three (3) Circles namely—Southern Circle, Northern Circle and Research & Development Circle. The Government of Mizoram has already constituted three Wildlife Sanctuaries in order to preserve its vanishing Wildlife. Four more Wildlife Sanctuaries are being proposed which are likely to be constituted very soon. The Mizoram Forest Department has created 1,00,029 hectares of plantation upto 1987 as against 967 hactares before it attained U.T. Status.

Issued by :
CHIEF CONSERVATOR OF FORESTS,
MIZORAM : AIZAWL.

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Regular Public auctions of sawn timber in various sizes for builders, Merchants, Contractors, etc, from their saw mills at Dandeli and Shimoga.

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Soon, KSFIC will diversify to market Flush doors and Block Boards from its manufacturing unit at Bangalore. It also has plans of marketing pulverised sandalwood powder from sandalwood white chips and spent wood in the immediate future.

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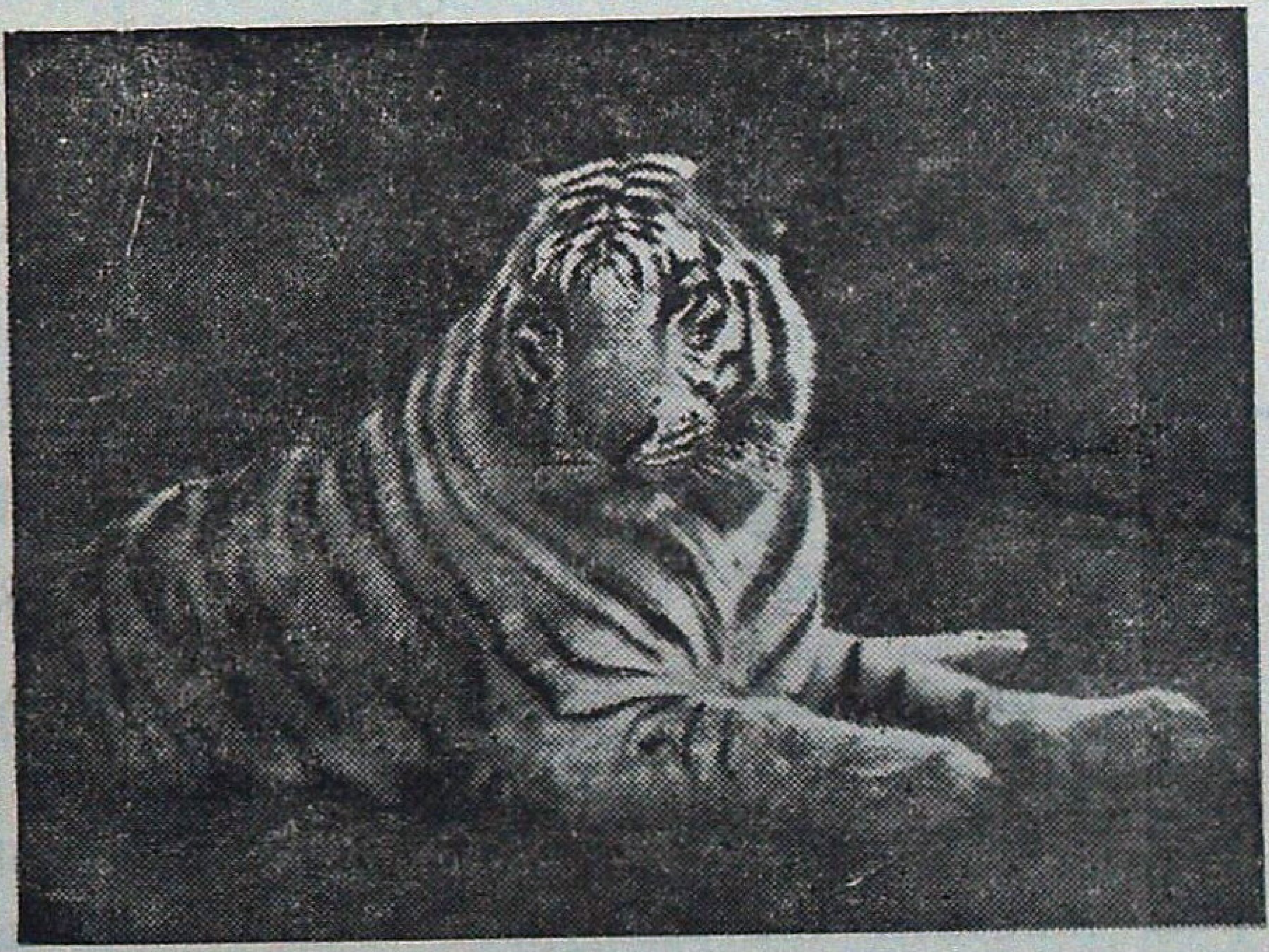

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The Director
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Punjab State Forest Development Corporation Limited

REGD OFFICE : KOTHI No 165, SECTOR 36-A, CHANDIGARH. Tel. : 40586

Punjab State Forest Development Corporation Limited has established the use of eucalyptus wood in building construction, truck body building, furniture making, battens, wooden crates, fabrication of packing cases, tool handles etc. Besides its use in paper and pulp industries the eucalyptus wood is also suited for chip / particle / fibre / ply-boards. Investigations got done from the Indian Plywood Industries Research Institute, Bangalore have shown that the eucalyptus timber grown in Punjab is suitable for making common grade plywood. Entrepreneurs desirous of setting up wood based industries can do so as huge quantity of eucalyptus wood is available at reasonable price in the State. The Corporation has wood seasoning facilities at its Phillaur complex.

Recently, the Corporation has established the use of eucalyptus on commercial scale in fabrication of packing cases and manufacturing door and window frames.

For further details, please contact the Managing Director, Punjab State Forest Development Corporation Limited, Chandigarh.

Y.P. CHOWDHRY
MANAGING DIRECTOR

Madhya Pradesh Forges Ahead : Forestry for the People

Madhya Pradesh is the 'Guardian State' of India. Upper catchment areas of important rivers lay here. They are to be kept tree-clad.

Forests conserve Soil and Water besides ameliorating environment. Plantation targets from all sources stand at about two lakh hectares including Wasteland Development Progamme. People's participation in afforestation programme is encouraged through Social Forestry which covers the whole State. M.P. Forests are a great source of non-tax revenue. They generate eight-crore man-days of annual employment. Forestry-activities provide jobs to weaker sections of society in lean season.

Fuel-Fodder-Timber-Bamboo-Tendu Leaves-Sal-seed, Gums etc—all are derived from our Forests.

Forests harbour Wild Life too :

M.P. has 11 National Parks and 31 Game-Sanctuaries covering more than 11 per cent of the forest area.

Save Forests : Save Wild Life.

Issued by :

Director General of Forests,
Madhya Pradesh.

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For more details contact :
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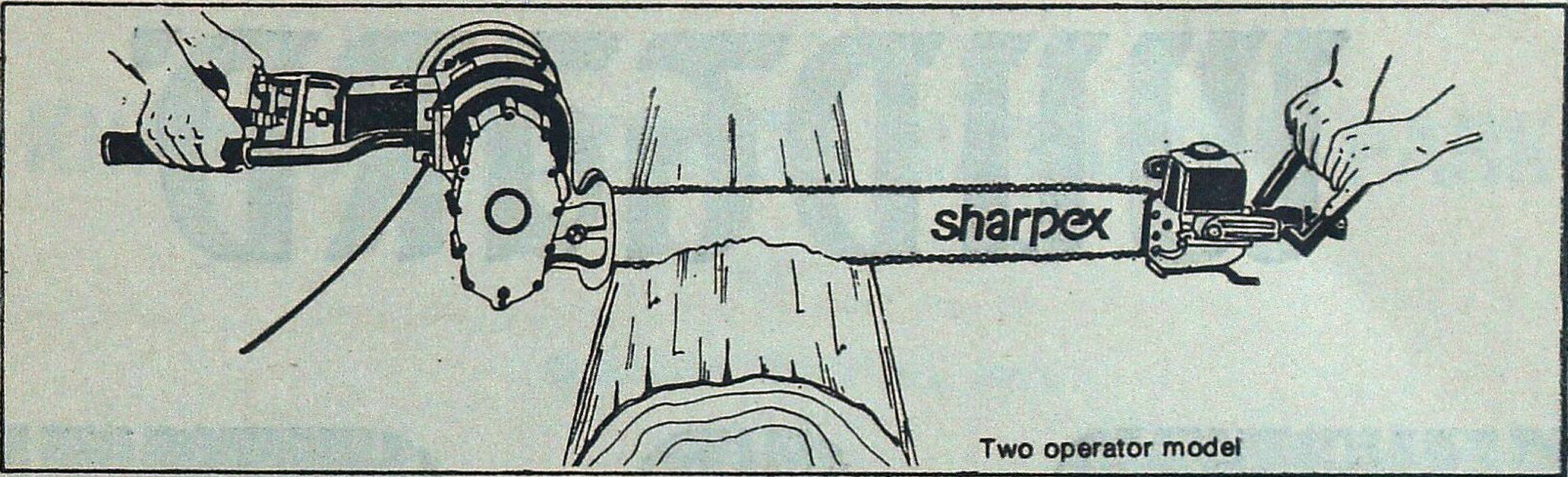
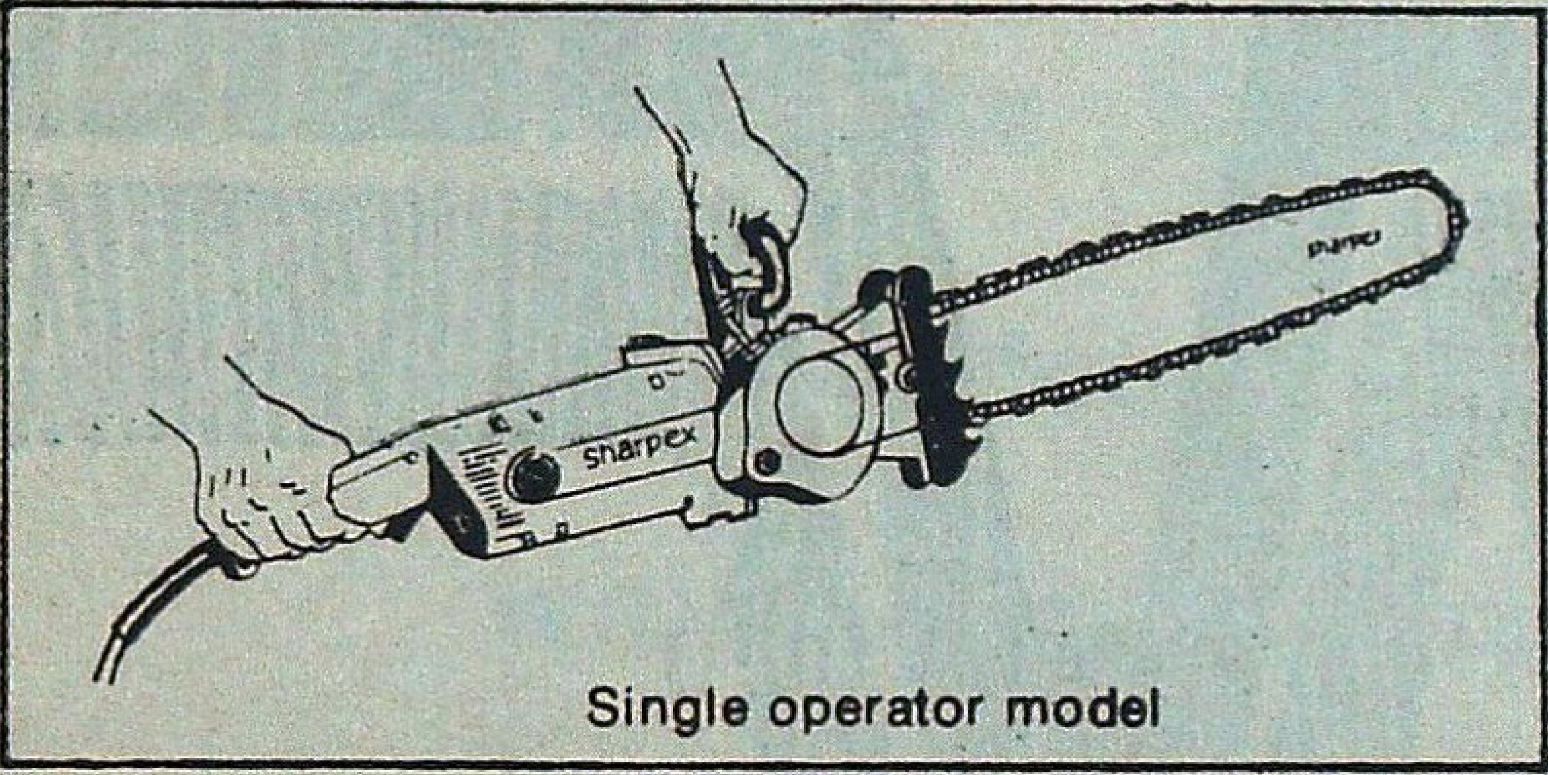
P.O. Sasan-gir - 362 135
Distt. Junagadh, Gujrat.



Two operator model



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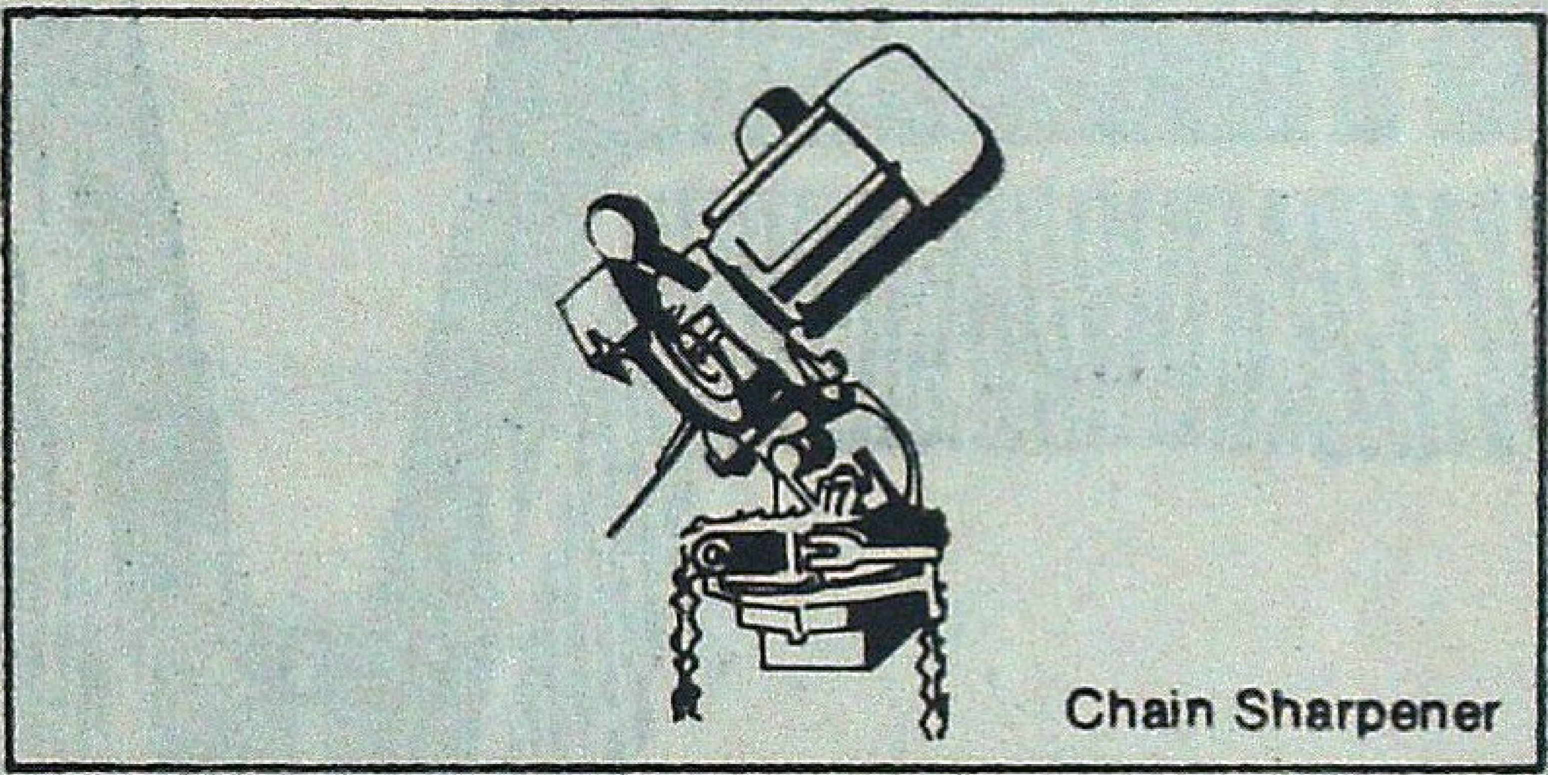
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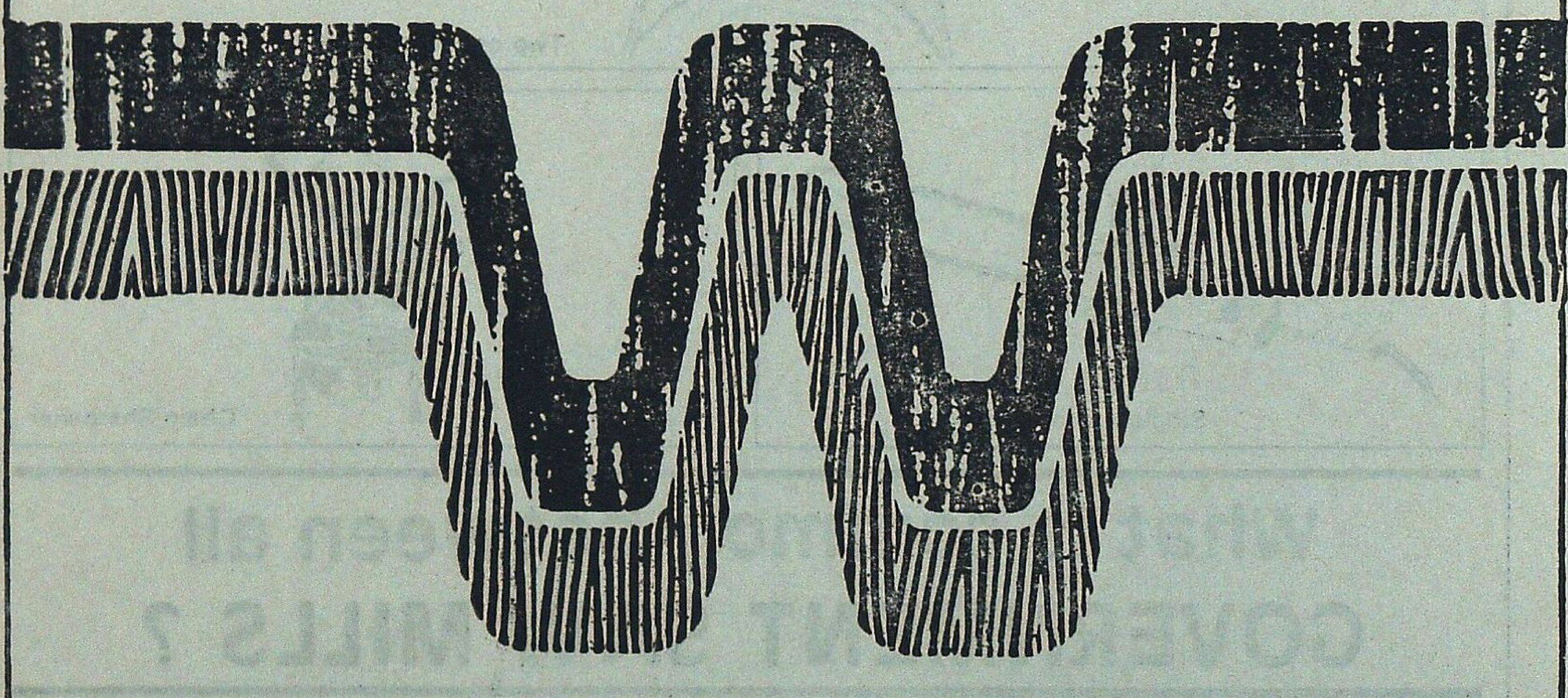

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